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UNE 22, 1942
OLUME 31, No. 13

AMERICAN

DYESTUFF REPORTER

FFICIAL PUBLICATION
of the
PROCEEDINGS
MERICAN ASSOCIATION
F TEXTILE CHEMISTS
AND COLORISTS

This pictures a dyeing problem
DESIGNING women's cloaking with the fibers now available is quite a job. You may have to work with materials you never used before—and some unusual combinations will result, which raise new dyeing problems. As an example, this construction for women's cloaking is one of many sent to Du Pont for a coloring recommendation:
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Weatherproofing an army of four million men . . . six million men . . . eight million men . . .

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Since 1820, the Butterworth Organization has served the Textile Industry—pioneering, building and improving machinery for the Wet End of Textile Finishing.

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—They are available in research quantities

Chemical	Formula	Boiling Point °C. at 760 mm.	Suggested Uses
Acetoacet-o-toluidide	$CH_3COCH_2CONHC_6H_4CH_3$	(a)	Dyestuff intermediate
Benzyl "Cellosolve"	$C_6H_5CH_2OCH_2CH_2OH$	256	High-boiling solvent
Butyl "Cellosolve" Acetate	$C_4H_9OCH_2CH_2OCOCH_3$	192	Lacquer solvent
"Dehydranone" (Dehydracetic Acid)	$CH_3COCHCOCH{:}C(CH_3)OCO$	(b)	Camphor-like plasticizer
Dichlorethyl Formal	$CH_2(OCH_2CH_2Cl)_2$	218	Elastomer intermediate
Dichlorisopropyl Ether	$(ClCH_2(CH_3)CH)_2O$	187	Textile assistant
Diethyl "Cellosolve"	$C_2H_5OC_2H_4OC_2H_5$	121	Nitrocellulose solvent
Diglycol Diacetate	$(CH_3COOCH_2CH_2)_2O$	250	Printing ink solvent
Diisopropanolamine	$(CH_3CHOHCH_2)_2NH$	249	Emulsifying agent intermediate
Dimethyl Dioxane	$OCH(CH_3)CH_2OCH_2CH(CH_3)$	117	Solvent, extractant
Dimethylethanolamine	$(CH_3)_2NCH_2CH_2OH$	133	Emulsifying agent intermediate
N-Ethyl Morpholine	$CH_3CH_2NCH_2CH_2OCH_2CH_2$	138	Solvent, emulsifying agent
Glycol Diformate	$HCOOCH_2CH_2OCOH$	177	Solvent, embalming agent
Hexanol	$CH_3(CH_2)_4CH_2OH$	157	Drug intermediate, perfumes
Hexyl Ether	$C_6H_{13}OC_6H_{13}$	226	Defoamer, inert reaction medium
Isopropanolamine	$CH_3CH(OH)CH_2NH_2$	160	Emulsifying agent, intermediate
Methyl "Carbitol" Acetate	$CH_3COOC_2H_4OC_2H_4OCH_3$	209	Printing ink solvent
Methyl "Cellosolve" Acetal	$CH_3CH(OCH_2CH_2OCH_3)_2$	207	Source of nascent acetaldehyde
Methyldiethanolamine	$CH_3N(C_2H_4OH)_2$	247	Intermediate, emulsifying agent
4-Methyl Dioxolane	$CH_3CHOCH_2OCH_2$	85	Cellulose acetate solvent
N-Methyl Morpholine	$CH_2CH_2OCH_2CH_2NCH_3$	115	Emulsifying agent, intermediate
N-Phenyl Morpholine	$C_6H_5NCH_2CH_2OCH_2CH_2$	(c)	Dyestuff intermediate
Polyethylene Glycols	$HO(CH_2CH_2O)xH$	(d)	Solvents, plasticizers, alkyd resins
Sodium Acetoacetyl-p-sulfanilate	$CH_3COCH_2CONHC_6H_4SO_3Na$	(e)	Dyestuff intermediate
Tetraethanolammonium Hydroxide	$(HOCH_2CH_2)_4NOH$	(f)	Solvent, strong base
Trichlorethane	$ClCH_2CHCl_2$	113	Solvent, extractant
Triglycol Dichloride	$ClC_2H_4OC_2H_4OC_2H_4Cl$	241	Solvent, plasticizer, intermediate

(a) Melts at 106°C. (b) Melts at 108°C. (c) Melts at 52 to 56°C. (d) Non-volatile, hygroscopic (e) Aqueous solution (f) Melts at 123°C.

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MUST WE SACRIFICE QUALITY IN OUR FABRIC DYEING?

Current comment in the press implies that the textile finishing industry will have to put up with substitute dyes—will have to be satisfied with inferior materials for conventional dyeing methods—that fabric dyeing can not be expected to maintain the present high standards of the industry—that fabrics will not have the same sun fastness and washability. Some even say we will not have gray goods.

We Do Not Think So!

The supply of cloth may be allotted, but whatever the available yardage, you need not sacrifice quality in the finishing. The answer to shortages of chemicals and plant equipment for conventional dyeing is pigment-dyeing with Aridye* pigmented emulsions. Using still relatively abundant materials, it is an entirely new method of applying color on textiles.

Restrictions will increase probably—but many fast pigments will not be greatly affected. Textile finishers can obtain plain shades by using this new method, and maintain the high standards of the industry. You can continue to get the same or better sun fastness and washability in shirtings, pyjamas, sportswear and work clothes; in fabrics of many kinds, including cottons, rayons, acetates and mixtures. Comparative tests show that the industry's high standards of fastness are more than met by this method of pigment-dyeing (Aridye Corporation's U. S. Pat. No. 2,248,696). This releases for military purposes sorely needed chemicals and production capacity.

Aridye colors for pigment-dyeing are emulsions. The pigments are dispersed in a solution of synthetic resins into which water is emulsified. This emulsion remains stable until dried; consequently there is no exhaustion of the bath, as all components are taken up by the fabric together in the same proportions.

Tests, covering Mildew Effectiveness, Resistance to Abrasion, Chlorine Retention, Air Porosity and Presence of Primary Irritating Substance, have been made by the United States Testing Company, Inc. Full copies of these reports will be sent on request.

Investigate these and other advantages of pigment-dyeing with Aridye pigmented emulsions. Send for additional information, including our standard form of license, under which many dyers are operating at present. Write to Aridye Corporation, a Subsidiary of Interchemical Corp., Fair Lawn, N. J.

*Reg. U. S. Pat. Off.

Aridye

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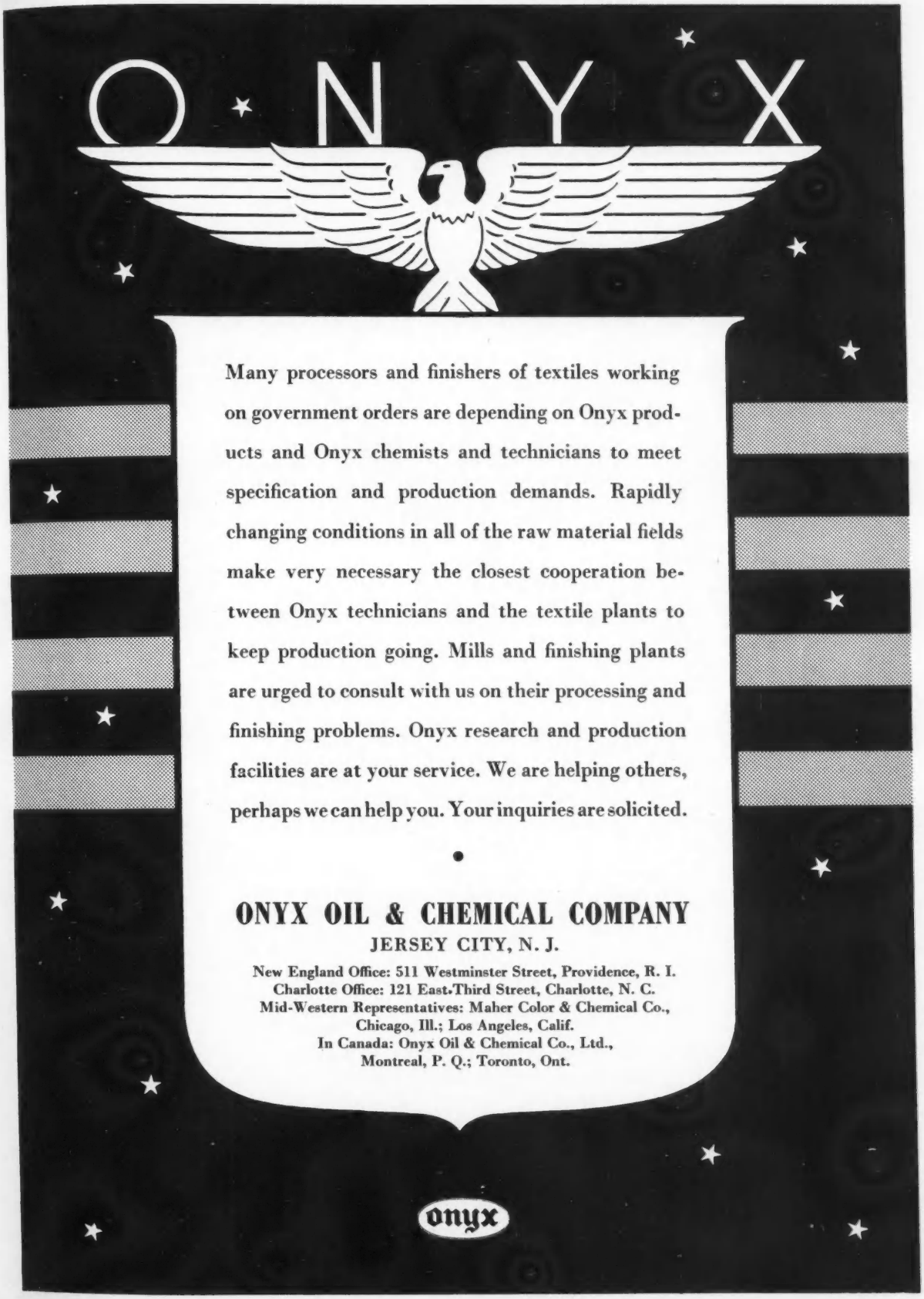

Many processors and finishers of textiles working on government orders are depending on Onyx products and Onyx chemists and technicians to meet specification and production demands. Rapidly changing conditions in all of the raw material fields make very necessary the closest cooperation between Onyx technicians and the textile plants to keep production going. Mills and finishing plants are urged to consult with us on their processing and finishing problems. Onyx research and production facilities are at your service. We are helping others, perhaps we can help you. Your inquiries are solicited.

•

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onyx

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How du Pont Research Speeds War Production

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Du Pont is helping to get uniforms for our Army and Navy with all speed. Of the millions of yards of cloth required, for instance, a tremendous amount must be bleached before dyeing. And out of du Pont research has come the greatest advance in bleaching in almost a hundred years. A new continuous bleach using du Pont peroxides changes grays to full white in 130 minutes compared with 8 to 14 hours for ordinary bleaching operations — saves time, power and chemicals. It's *fast!*

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To furnish dyes for uniforms, du Pont production of vat colors for military use has been increased 500% in the past three years and will be increased again this summer. Almost the entire output of these particular vat dyes was going into military goods by the end of 1941. Du Pont is now supplying more than half of all the anthraquinone vat dyes used in cotton uniforms and about 30% of all dyes for wool uniforms. This peak production has been reached with unparalleled speed. *Fast!*

These and other du Pont developments and products have contributed materially to 'dressing' our growing Army and Navy—*fast!*

* * *

Behind all these contributions stands the du Pont Technical Service man. He is backed by 140 years of service to industry...140 years of experience in solving difficult problems. Call on him when you need help.

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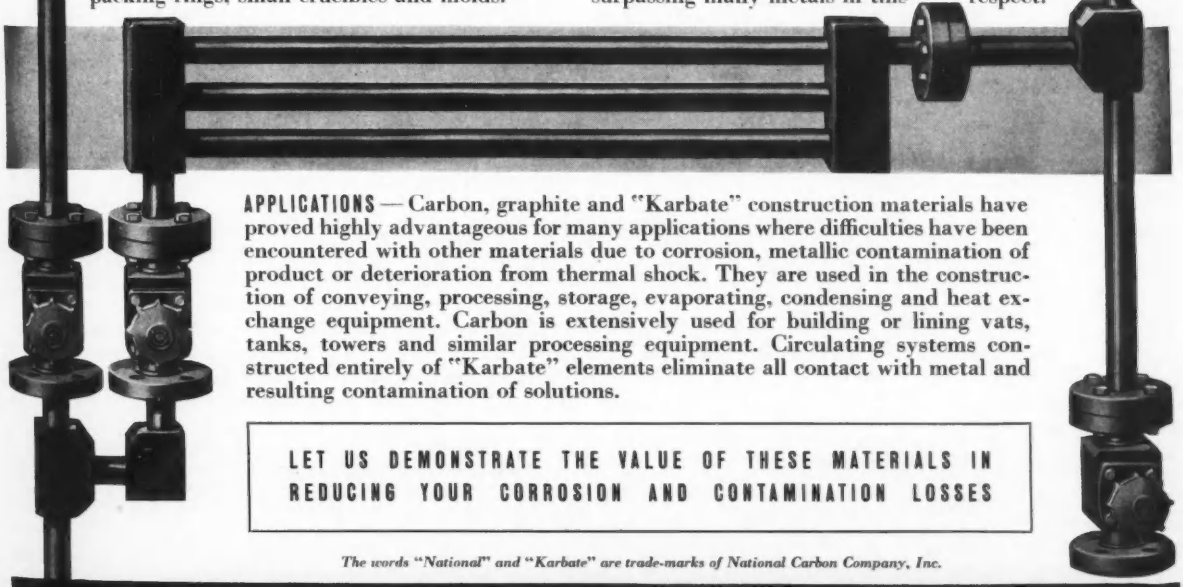

APPLICATIONS—Carbon, graphite and "Karbate" construction materials have proved highly advantageous for many applications where difficulties have been encountered with other materials due to corrosion, metallic contamination of product or deterioration from thermal shock. They are used in the construction of conveying, processing, storage, evaporating, condensing and heat exchange equipment. Carbon is extensively used for building or lining vats, tanks, towers and similar processing equipment. Circulating systems constructed entirely of "Karbate" elements eliminate all contact with metal and resulting contamination of solutions.

LET US DEMONSTRATE THE VALUE OF THESE MATERIALS IN REDUCING YOUR CORROSION AND CONTAMINATION LOSSES

The words "National" and "Karbate" are trade-marks of National Carbon Company, Inc.

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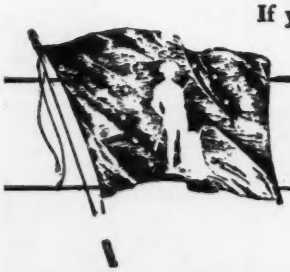

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SYNTHETICS from SAWMILLS?

Fibers of California Redwood bark have long been used for cold-storage insulation. Now short, fine Redwood fibers are being mixed with wool, then carded, combed, spun and woven into cloth that simulates pure-wool fabric.

Newest example of textile research to alleviate the wool shortage, this mixture of animal and vegetable fibers is indicative of the strange combinations that will tend to complicate traditional dyehouse techniques. But whatever the fibers or fabrics of the present or the future, National Technical Service will be ready with the formulas and color stocks to give you an exact match to your fastness standard.

First and always—refer your technical problems to nearby National Technical Service.

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AMERICAN
DYESTUFF REPORTER

VOLUME 31 JUNE 22, 1942 NUMBER 13

A Comparison of the Efficiencies of Home and Commercial LAUNDRY PROCESSES

ELIZABETH LOVELL*, JESSIE ROBERTS and JESSIE BRODIE
Department of Household Science, University of Toronto

THE problem of home versus commercial laundering has been one of much controversy and up to the present very little has been done, by unbiased workers, to enlighten the home manager. Faced with the ever-increasing use of advertising by both the manufacturers of home washing machines and the commercial laundryowners, the housewife today finds herself the victim of high pressure advertisements, the claims of which are in some instances based on little or no scientific work. In many cases she is confused by the numerous terms used by commercial laundries and is prejudiced by the work of some laundryowners who are indifferent to quality work. She is unaware of the differences in workmanship and control encountered in the many types of commercial laundry machines and is apt to condemn the whole on the faults of the few. If the confusion is to be eliminated from the consumer's mind facts regarding the washing efficiencies of the various machines and of the controlled commercial method must be made available.

To date the published work on this subject has been limited. The results of such workers as Ginter and Morris[1], Ginter and Rhodes[2] and Snyder and Winegar[3] have shown the domestic process to be superior to the commercial from the standpoint of tensile strength loss, while those of Epple and Johnson[4] indicate the reverse to be the case. This investigation was undertaken to determine the situation in Canada. The problem was set up so that the results might be investigated statistically, taking account of the inherent variability of the cotton material used. The work was so arranged that the effects of indoor and outdoor drying might be compared (Series I and II) and that the efficiencies of various combinations of the mechanical equipment of the machines might be investigated and compared with the commercial process (Series I, III, IV, V, VI). Outdoor drying with domestic machines rather than indoor was chosen for the latter comparison for it was felt that this was an outstanding factor in home methods, since many housewives prefer the home method largely on this account. For the domestic process test bundles were washed in a standard procedure outlined below. For the commercial process a Toronto laundry, which maintains membership in the American Institute of Laundering and in The Canadian Research Institute of Launderers and Cleaners and has had consistently their approval, was chosen. Due to the strict control imposed on the members of these institutes, the quality of workmanship is maintained.

Six series were planned as follows:

Series

I—Gyrator washing machine, wringer to extract water, and drying outdoors.

II—Gyrator washing machine, wringer to extra water, and drying indoors.

III—Gyrator washing machine, spinner to extract water, and drying outdoors.

IV—Vacuum cup washing machine, wring to extract water, and drying outdoors.

V—Vacuum cup washing machine, spinner to extract water, and drying outdoors.

VI—Controlled commercial process—approved by American Institute of Laundering and Canadian Research Institute of Launderers and Cleaners.

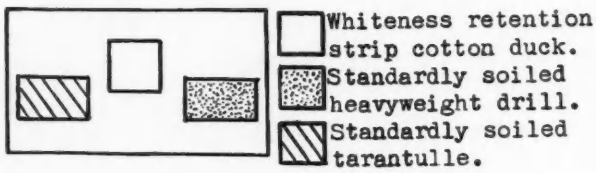
TEST BUNDLES

The materials for the test bundles were obtained from the National Research Council, Ottawa, Canada. They consisted of (1) a high grade unsized tarantulle sheeting for the determination of tensile strength and fluidity, (2) a standardly soiled heavy weight drill, and a standardly soiled tarantulle sheeting for the determination of detergency efficiency and (3) a white cotton duck for the determination of whiteness retention. With the exception of the soiled tarantulle sheeting, the materials used were those employed in testing the efficiencies of Canadian laundries. The soiled tarantulle was included in this investigation so that the removal of soil from light weight material as well as from heavy weight might be studied. For soiling, the drill and sheeting free from size were wetted first in a 0.1 per cent solution of Orvus†, rinsed thoroughly in distilled water and extracted for 15 seconds

*Submitted in partial fulfillment of the requirements for the degree of Master of Arts, University of Toronto.

†Procter & Gamble.

in a centrifuge. A fifteen foot length of the material, with the ends sewn together, was given 15 passes through a 1 per cent "aquadag"* solution with squeezing between rubber rolls after each passage. After drying, first at room temperature, and finally in an oven at 110° C., this was cut into the strips for the test bundles. The two soiled samples and the white duck were sewn onto the sheeting as in the diagram below. In the commercial process these



were washed as individual bundles. In the domestic, 5 were sewn together to facilitate the removal of 5 at a time and to eliminate tangling. The size of the 5 sewn together approximated that of a single bed sheet.

Three test bundles, from each of the two bolts of sheeting used, were kept as controls. These were subjected to a standard boil at the National Research Council laboratories, extracted and ironed on a flat bed presser.

*Acheson Colloids Corporation, Port Huron, Mich., U. S. A. (A concentrated aqueous suspension of colloidal graphite.)

THE DOMESTIC PROCESS

Standard home laundry equipment was used throughout the experiment. Vacuum cup and gyrator washing machines were used in combination with wringer and spinner attachments. Indoor drying was done in a steam drier, the outdoor drying on the roof of the building. The supplies consisted of (1) water containing 9 grains of hardness per gallon; (2) a pure soap flake available on the Toronto market; (3) sodium carbonate in the amount calculated to soften the water, and (4) Reckitt's blue. Five series of 20 test bundles each were washed by the procedure given below. Five test bundles from each series were removed for testing after 10, 25, 50 and 100 washings.

TABLE I
Domestic Laundering Process, Series I to V

Process	*Equipment Used*	*Supplies*	*Time (Min.)*	*Temperature °C.*
Soak	porcelain laundry tub	water—9 gal.	10 (approx.)	32
Suds	(a) gyrator machine	water—12½ gal.	8 (exact)	67
		Na_2CO_3—7.5 gm.		
		soap—175.0 gm.*		
	(b) vacuum cup machine	water—10 gal.	8 (exact)	67
		Na_2CO_3—6 gm.		
		soap—140 gm.*		
Rinse	porcelain laundry tub	water—9 gal.	10 (approx.)	32
Rinse	(a) gyrator machine	water—12½ gal.	8	67
	(b) vacuum cup machine	water—10 gal.	8	67
Rinse	porcelain laundry tub	water—9 gal.	dipped 3X	cool†
Blue	porcelain laundry tub	water—9 gal.	dipped 3X	cold
		blue—3.4 gm.		

*Soap to make a 0.3 per cent solution. †The temperature was raised because the clothes came from the scalding rinse.

THE COMMERCIAL PROCESS

The 20 test bundles washed commercially were subjected to a standard multiple suds formula approved by the American Institute of Laundering. The soap solution for this was made of 30 pounds of soap in 120 gallons of Permutite softened water, and the builder of 25 pounds of caustic soda to 60 gallons of water. As in the domestic process 5 bundles were removed after 10, 25, 50 and 100 washings.

TABLE II
Commercial Laundering Process, Series VI

	Process	*Equipment Used*	*Water Level (In.)*	*Supplies*	*Time (Min.)*	*Temperature °F.*
1.	Suds	42" x 96"	6	soap solution* 5 gal., builder† 8 qts.	10	120
2.	Suds	Monel Wash Cylinder	6	soap solution ½ gal.	10	140
3.	Suds	Monel Wash Cylinder	6	soap solution 1 qt., bleach 2 per cent 4 qts.	10	150
4.	Rinse	Monel Wash Cylinder	10	water softened	5	170
5.	Rinse	Monel Wash Cylinder	10	water	5	180
6.	Rinse	Monel Wash Cylinder	10	water	5	180
7.	Rinse	Monel Wash Cylinder	10	water	5	170
8.	Blue and sour	Monel Wash Cylinder	6–10	blue	5	130–90
				sour 5 per cent sodium-silico-fluoride		

*Soap solution is made up of 30 lbs. of soap in 120 gallons of water. †Builder is made up of 25 lbs. of caustic soda to 60 gallons of water.

TESTS

Standard methods as outlined by the A.S.T.M. were followed for tensile strength and fluidity determinations. Whiteness retention and soil removal were determined on a Hunter reflectometer. All samples were conditioned to 65 per cent relative humidity and 70° F. in a controlled testing laboratory prior to testing the tensile strength and fluidity.

RESULTS

TABLE III
Mean Tensile Strength in Pounds, Grab Method

	No. of Washes	Domestic: Gyrator Wringer Indoors	Domestic: Gyrator Wringer Outdoors	Domestic: Gyrator Spinner Outdoors	Domestic: Vacuum Cup Wringer Outdoors	Domestic: Vacuum Cup Spinner Outdoors	Commercial	Control
Warp	10	44.2	43.4	41.0	44.9	43.8	43.5	
	25	43.7	42.0	40.5	42.6	42.8	45.4	44.3
	50	43.6	41.8	39.4	42.8	42.8	44.4	
	100	46.4	38.1	38.7	39.2	41.8	40.8	
Weft	10	49.0	47.4	47.6	50.0	50.2	50.4	
	25	51.3	47.2	45.9	46.6	50.6	50.5	49.8
	50	51.1	47.3	44.9	46.6	48.8	48.3	
	100	51.8	42.6	38.3	42.3	43.8	42.2	

TABLE IV
Fluidity Increase (Final Fluidity Minus Fluidity Control) Mean Values

No. of Washes	Domestic: Gyrator Wringer Outdoor	Domestic: Gyrator Spinner Outdoor	Domestic: Vacuum Cup Wringer Indoor	Domestic: Vacuum Cup Wringer Outdoor	Domestic: Vacuum Cup Spinner Outdoor	Commercial
10	2.1	1.4	0.0	1.6	1.4	—0.5
25	3.5	2.6	1.2	3.4	3.1	0.2
50	7.5	6.0	3.8	6.9	6.7	2.3
100	12.0	11.3	6.1	12.4	11.6	5.6

TABLE V
Detergency Efficiency—Soiled Tarantulle Mean Values

No. of Washes	Domestic: Gyrator Wringer Outdoor	Domestic: Gyrator Spinner Outdoor	Domestic: Vacuum Cup Wringer Indoor	Domestic: Vacuum Cup Wringer Outdoor	Domestic: Vacuum Cup Spinner Outdoor	Commercial	Control
10	45.0	42.0	41.8	40.5	40.8	66.2	22.7
25	57.1	48.6	52.0	50.4	48.8	76.8	22.7
50	62.2	56.1	57.4	60.1	55.5	77.7	22.7
100	72.0	69.4	64.2	72.6	65.0	77.6	22.7

TABLE VI
Detergency Efficiency—Soiled Drill Mean Values

No. of Washes	Domestic: Gyrator Wringer Outdoor	Domestic: Gyrator Spinner Outdoor	Domestic: Vacuum Cup Wringer Indoor	Domestic: Vacuum Cup Wringer Outdoor	Domestic: Vacuum Cup Spinner Outdoor	Commercial	Control
10	39.6	32.1	34.0	34.2	30.2	52.0	12.4
25	49.4	43.6	50.1	48.7	40.2	68.5	12.4
50	60.0	48.9	53.8	55.2	49.5	76.5	12.4
100	70.6	58.1	60.0	67.3	58.5	77.1	12.4

TABLE VII
Whiteness Retention Readings Mean Values

No. of Washes	Domestic: Gyrator Wringer Outdoor	Domestic: Gyrator Spinner Outdoor	Domestic: Vacuum Cup Wringer Indoor	Domestic: Vacuum Cup Wringer Outdoor	Domestic: Vacuum Cup Wringer Outdoor	Commercial	Control
10	77.9	76.9	76.8	77.2	74.5	79.4	86.9
25	77.7	77.6	76.8	77.0	74.0	76.5	86.9
50	78.3	76.5	77.2	76.7	74.8	77.6	86.9
100	81.3	79.4	77.9	79.5	77.5†	76.3	86.9

*A missing value contributing to this mean was estimated by the formula developed by Allan and Wishart (Methods of Statistical Analysis—Goulden).

Since the variation in the results is due partly to the variability of the cotton material itself, it is necessary to divide the total variability into its component parts before the results from the different methods may be compared satisfactorily. The variance found within the textile material itself constitutes the error of the experiment. With this error variance, the estimate of the variance between methods may be compared. Only in those cases where the variance between methods is significantly great may conclusions regarding the efficiencies be drawn. The statistical analysis of the data is given in Tables VIII-XIV.

TABLE VIII
Analysis of Variance for Tensile Strength Results Showing the Effect of Indoor and Outdoor Drying (See Table III)
Series I—Gyrator, Wringer—Indoor Drying
Series II—Gyrator, Wringer—Outdoor Drying

No. of Washes			Sums of Squares	Degrees of Freedom	Variance	°F.	5% Pt.
10	Warp	Between Methods	3.2	1	3.2	1.6	5.12
		Within Methods	18.0	9	2.0		*
	Weft	Between Methods	13.61	1	13.61	1.72	5.12
		Within Methods	71.11	9	7.90		*
25	Warp	Between Methods	14.11	1	14.11	3.41	5.12
		Within Methods	37.23	9	4.14		*
	Weft	Between Methods	86.11	1	86.11	12.91	5.12
		Within Methods	59.99	9	6.67		†
50	Warp	Between Methods	18.05	1	18.05	6.71	5.12
		Within Methods	24.20	9	2.69		†
	Weft	Between Methods	71.49	1	71.49	8.32	5.12
		Within Methods	77.35	9	8.59		†
100	Warp	Between Methods	348.61	1	348.61	168.41	5.12
		Within Methods	18.65	9	2.07		†
	Weft	Between Methods	423.2	1	423.00	211.6	5.12
		Within Methods	18.0	9	2.0		†

*Variance between methods is not significantly greater than that within. †Variance between methods is significantly greater than that within.

The above analysis shows that outdoor drying is causing a significant decrease in the tensile strength of the material. The sunshine, wind and other such factors, are more destructive than the conditions met in inside drying.

The analysis given in Table IX was made to find out whether the differences in the tensile strength results obtained on using the machine combinations are significant.

TABLE IX

Analysis of Variance for Tensile Strength Results Showing the Effect of a Series of Machine Combinations (See Table II)

Series I. Gyrator Wringer
Series II. Gyrator Spinner
Series III. Vacuum Cup Wringer
Series IV. Vacuum Cup Spinner

(Outdoor Drying Was Used Throughout the 4 Series)

No. of Washes			*Sums of Squares*	*Degrees of Freedom*	*Variance*	*°F.*	*5% Pt.*
10	Warp	Between Methods	81.88	3	27.29	18.07	3.86 †
		Within Methods	13.60	9	1.51		
	Weft	Between Methods	69.07	3	23.02	9.51	3.86 †
		Within Methods	21.82	9	2.42		
25	Warp	Between Methods	32.26	3	10.75	8.81	3.86 †
		Within Methods	11.00	9	1.22		
	Weft	Between Methods	131.21	3	43.74	15.03	3.86 †
		Within Methods	26.18	9	2.91		
50	Warp	Between Methods	74.92	3	24.97	9.87	3.86 †
		Within Methods	22.97	9	2.53		
	Weft	Between Methods	79.72	3	26.57	4.69	3.86 †
		Within Methods	51.04	9	5.67		
100	Warp	Between Methods	77.91	3	25.97	13.39	3.86 †
		Within Methods	17.48	9	1.94		
	Weft	Between Methods	171.46	3	57.15	16.10	3.86 †
		Within Methods	31.93	9	3.55		

*Variance between methods is not significantly greater than that within.
†Variance between methods is significantly greater than that within.

Since the differences between methods are significantly great it is necessary to determine where the significant differences are. This may be done by testing the significance of the differences between the means by calculation of "t" values. The weft tensile strength only is used for the variation in weft is greater than that found in the warp. Comparisons for this are made as follows:

(1) Gyrator wringer with gyrator spinner.
(2) Vacuum cup wringer with vacuum cup spinner.
(3) Gyrator wringer with vacuum cup wringer.
(4) Gyrator spinner with vacuum cup spinner.
(5) Gyrator wringer with commercial.
(6) Gyrator spinner with commercial.
(7) Vacuum cup wringer with commercial.
(8) Vacuum cup spinner with commercial.

TABLE X

Calculations of t Values for Weft Tensile Strength After 100 Washes. Outdoor Drying Used for Domestic Processes

Method	*Difference Between Means* $\bar{X}_1-\bar{X}_2$	*S*	*t*	*P*
Vacuum cup wringer vs. vacuum cup spinner	1.5	2.22	1.51	>.10
Gyrator wringer vs. gyrator spinner	4.3	2.70	3.56	<.01*
Gyrator wringer vs. vacuum cup wringer	0.3	1.29	0.52	>.50
Gyrator spinner vs. vacuum cup spinner	5.5	3.25	3.78	<.01*
Gyrator wringer vs. commercial	0.4	1.59	0.56	>.50
Gyrator spinner vs. commercial	3.9	2.80	3.11	<.01*
Vacuum cup wringer vs. commercial	0.1	1.48	0.15	>.80
Vacuum cup spinner vs. commercial	1.6	2.40	1.49	<.10

*Significant difference.
P = Probability levels based on distribution of t (Fisher—Statistical Methods for Research Workers '30)[6].

The results, given in Table X show that, after 100 washings, a significant decrease in weft tensile strength occurs only with the gyrator in combination with the spinner.

The significances of the difference between means were calculated also for fluidity increase, soil removal from both light and heavy weight material and whiteness retention. These results are given in Tables XI-XIV.

TABLE XI
Calculations of t Values for Fluidity Increase After 100 Washes

Method	*Difference Between Means* $\bar{X}_1-\bar{X}_2$	*S*	*t*	*P*
Vacuum cup wringer outdoor vs. vacuum cup spinner outdoor	0.8	0.96	1.30	>.2
Gyrator wringer outdoor vs. gyrator spinner outdoor	0.7	0.80	1.38	>.2
Gyrator wringer outdoor vs. vacuum cup wringer outdoor	0.4	0.74	0.85	>.4
Gyrator spinner outdoor vs. vacuum cup spinner outdoor	0.3	1.01	0.47	>.6
Gyrator wringer outdoor vs. gyrator wringer indoor	5.9	0.63	14.80	<.01*
Gyrator wringer outdoor vs. commercial	6.4	0.72	14.04	<.01*
Gyrator wringer indoor vs. commercial	0.5	0.66	1.20	>.2
Gyrator spinner outdoor vs. commercial	5.7	0.83	10.85	<.01*
Vacuum cup wringer outdoor vs. commercial	6.8	0.77	13.95	<.01*
Vacuum cup spinner outdoor vs. commercial	6.0	0.95	9.98	<.01*

*Significant difference.
P = Probability levels based on distribution of t (Fisher '30)[6].

Evidently chemical degradation is least when the clothes are dried indoors as in the commercial method and the home method employing indoor drying. Over a period of 100 washings a significant increase in fluidity over the commercial method was shown statistically by all methods using outdoor drying. No significant differences were found between the various combinations of domestic equipment.

TABLE XII
Calculation of t Values for Detergency Efficiency. (Light Weight Cotton), 100 Washes. Tarantulle

Method	*Difference Between Means* $\bar{X}_1-\bar{X}_2$	*S*	*t*	*P*
Vacuum cup wringer outdoor vs. vacuum cup spinner outdoor	7.6	1.62	7.41	<.01*
Gyrator wringer outdoor vs. gyrator spinner outdoor	2.6	1.43	2.87	<.01*
Gyrator wringer outdoor vs. vacuum cup wringer outdoor	0.6	0.92	1.03	>.30
Gyrator spinner outdoor vs. vacuum cup spinner outdoor	4.4	1.96	3.55	<.01*
Gyrator wringer outdoor vs. gyrator wringer indoor	7.8	1.42	8.68	<.01*
Gyrator wringer outdoor vs. commercial	5.6	0.70	12.64	<.01*
Gyrator wringer indoor vs. commercial	13.4	1.30	16.27	<.01*
Gyrator spinner outdoor vs. commercial	8.2	1.31	9.89	<.01*
Vacuum cup wringer outdoor vs. commercial	5.0	0.71	11.13	<.01*
Vacuum cup spinner outdoor vs. commercial	12.6	1.50	13.27	<.01*

*Significant difference.
P = Probability levels based on distribution of t (Fisher '30)[6].

TABLE XIII
Calculation of t Values for Detergency Efficiency. (Heavy Weight Cotton), 100 Washes. Drill

Method	*Difference Between Means* $\bar{X}_1-\bar{X}_2$	*S*	*t*	*P*
Vacuum cup wringer outdoor vs. vacuum cup spinner outdoor	8.8	1.91	7.28	<.01*
Gyrator wringer outdoor vs. gyrator spinner outdoor	12.5	1.91	10.34	<.01*
Gyrator wringer outdoor vs. vacuum cup wringer outdoor	3.3	0.93	5.60	<.01*
Gyrator spinner outdoor vs. vacuum cup spinner outdoor	0.4	2.54	0.25	>.80
Gyrator wringer outdoor vs. gyrator wringer indoor	10.6	1.25	13.40	<.01*
Gyrator wringer outdoor vs. commercial	6.5	0.87	11.80	<.01*
Gyrator wringer indoor vs. commercial	17.1	1.16	23.29	<0.1*
Gyrator spinner outdoor vs. commercial	19.0	1.86	16.14	<0.1*
Vacuum cup wringer outdoor vs. commercial	9.8	0.81	19.16	<0.1*
Vacuum cup spinner outdoor vs. commercial	18.6	1.89	15.55	<0.1*

*Significant difference.
P = Probability levels based on distribution of t (Fisher '30)[6].

After 100 washings, the washing processes may be rated, in order of efficiency in soil removal from the tarantulle, as (1) commercial, (2) vacuum cup and gyrator with wringer and outdoor drying, (3) gyrator with spinner and outdoor drying, (4) vacuum cup with spinner and outdoor drying and (5) gyrator with wringer and indoor drying. With the drill the efficiency in methods rates as (1) commercial, (2) gyrator with wringer and outdoor drying, (3) vacuum cup with wringer and outdoor drying, (4) gyrator with wringer and indoor drying and (5) vacuum cup and gyrator with spinner and outdoor drying.

It is evident that the wringer makes a greater contribution to soil removal than the spinner.

TABLE XIV
Calculations of t Values for Whiteness Retention After 100 Washes

Method	*Difference Between Means* $\bar{X}_1-\bar{X}_2$	*S*	*t*	*P*
Vacuum cup wringer outdoor vs. vacuum cup spinner outdoor	2.0	1.34	2.36	>.05*
Gyrator wringer outdoor vs. gyrator spinner outdoor	1.9	0.76	3.95	>.01*
Gyrator wringer outdoor vs. vacuum cup wringer outdoor	1.8	1.20	2.37	>.05*
Gyrator spinner outdoor vs. vacuum cup spinner outdoor	1.9	0.96	3.13	>.02*
Gyrator wringer outdoor vs. gyrator wringer indoor	1.4	0.66	3.35	>.02*
Gyrator wringer outdoor vs. commercial	5.0	0.61	12.95	<.01
Gyrator wringer indoor vs. commercial	3.6	0.31	18.96	<.01*
Gyrator spinner outdoor vs. commercial	3.1	0.48	10.20	<.01*
Vacuum cup wringer outdoor vs. commercial	3.2	1.05	4.82	<.01*
Vacuum cup spinner outdoor vs. commercial	1.2	0.85	2.23	>.05*

*Significant difference.
P = Probability levels based on distribution of t (Fisher '30)[6].

There is a significant difference in whiteness retention in all methods after 100 washings, as shown in Table XIV. From this standpoint the methods would be listed in the following order, (1) gyrator with wringer and outdoor drying, (2) gyrator with spinner and outdoor drying and vacuum cup with wringer and outdoor drying, (3) gyrator with wringer and indoor drying, (4) vacuum cup with spinner and outdoor drying and (5) commercial.

DISCUSSION

The analysis of the tensile strength results shows that: (1) the loss in strength when cotton is dried outdoors rather than indoors is significant; (2) in the use of the gyrator spinner combination of equipment only a significant decrease is found. Since, to the writer's knowledge, the manufacturers do not, at the present time, make the combination of gyrator with spinner attachment, it may be concluded that the domestic washing machines and the controlled commercial method give comparable results as far as tensile strength is concerned.

As measured by fluidity increase chemical degradation is least when cotton is dried indoors. In the case of the commercial method and the domestic with the indoor drying, the increase at the end of 100 washings was approximately one-half that of the domestic methods using outdoor drying. Home methods using indoor drying compare favorably with the commercial method with respect to chemical degradation as shown by fluidity increase.

The total detergency efficiency obtained is greater for the commercial than for the domestic process. The commercial process removes the soil in a fewer number of washes than the domestic. Before the fiftieth wash more soil was removed by the commercial process than by 100 domestic washings. In all cases the greatest soil removal per 100 washes is obtained by the tenth wash. This is most apparent in the commercial process where 85 per cent of the total soil from the tarantulle and 67 per cent from the drill is eliminated in the first ten washes. In detergency efficiency it appears that the commercial process is superior to the home methods, the wringer is superior to the spinner and outdoor drying to indoor drying. In some cases the gyrator seems more efficient than the vacuum cup but it must be pointed out that results are not consistent for all combinations. However, in the two instances where there was a significant difference after 100 washings the gyrator gave superior results.

Although at the conclusion of 10 commercial washes whiteness retention was greater than that found with any of the domestic methods, by the end of 100 commercial washes the value had decreased and was lower than that from any of the home methods. This decrease may be due to the fact that in each commercial wash the test bundles were placed in the wheel with ordinary soiled clothes, while in the domestic method clean clothes made up the load required for each wash. On the other hand since a significant difference in whiteness retention was shown between clothes dried indoors and outdoors it would seem probable that the decreased whiteness retention after 100 commercial washings was due partly to lack of outdoor drying. The domestic processes show a more gradual change and the whiteness retention after 100 washes had increased over the whiteness retention found at the end of 10 washes.

For a period of 10 washes the commercial method is superior to the domestic method since the decrease in tensile strength is comparable to that present with the domestic processes, the fluidity increase is less and the whiteness retention with both the tarantulle and drill is greater. For the period of 100 washes the commercial process again gave the most satisfactory results when all factors are considered. Its detergency efficiency is greatest, the degradation is less than that encountered in all domestic processes dried outdoors and is equalled only by a domestic process using indoor drying, a method not used extensively. Though the whiteness retention of the commercially washed strips was significantly lower than that found with the domestic processes this comparison as pointed out above, was not made on a fair basis.

The gyrator and vacuum cup washing machines as found on the Toronto market exerted similar effects in degradation as measured by tensile strength and fluidity increase. The gyrator washing machine however was superior to the vacuum cup machine in whiteness retention and soil removal in some cases.

(Concluded on page 324)

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JUNE 22, 1942

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Calendar of Coming Events

Council and Research Committee Meetings, New York, N. Y., June 27, 1942.

Annual Meeting and Convention, Atlantic City, N. J., October 8, 9, 10 and 11, 1942.

Volumetric Determination of MOISTURE IN COTTON TEXTILES*

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THE determination of water in mixtures by titration with a special reagent containing iodine, sulfur dioxide and pyridine dissolved in methanol, was first described by Karl Fischer[1]. Mitchell, Smith, and Bryant have made an exhaustive study of the nature of the reagent[2], and of its application in the determination of alcoholic hydroxyl[3], organic acids[4], acid anhydrides[5, 6], water in the presence of carbonyl compounds[7], and carbonyl compounds[8]. These writers recommend the Fischer analytical technique for the determination of water in the following classes of organic compounds: alcohols, hydrocarbons, carboxylic acids (except formic acid) and esters. Almy, Griffin, and Wilcox[9] have shown that the end point of the titration can be determined potentiometrically as well as colorimetrically.

Mitchell[10] has determined moisture in various forms of cellulose by cold extraction with methanol, followed by direct titration of water in the methanol solution with the Karl Fischer reagent. He applied the method successfully to alpha cellulose, cardboard, newspaper, wood pulp, cotton linters, and several kinds of native wood. In view of the simplicity and the speed of the volumetric method of moisture determination, it seemed advisable to investigate the possibility of determining the moisture regain in cotton textiles by this method and to compare its accuracy with the present standard oven-drying procedure specified by the American Society for Testing Materials (Section 4 of A. S. T. M. Tentative Stand, D 629)[11].

EXPERIMENTAL PROCEDURE

Preparation of the Karl Fischer Reagent

The reagent was prepared, in accordance with the directions previously published[2], by dissolving 84.7 g. (0.33 mole) of resublimed U. S. P. iodine in a mixture of 269 ml. (3.3 moles) of pyridine and 667 ml. of synthetic methanol. The water content of the solvents (methanol and pyridine) did not exceed 0.1 per cent. The above solution was cooled in a slurry of chopped ice and 64 g. (1 mole) of liquid sulfur dioxide was cautiously added. The final solution was dark brown in color.

The reagent was standardized by weighing about 18 ml. of distilled water carefully into a liter volumetric flask, making up to volume with synthetic methanol, and titrating 10-ml. aliquots of this solution with the reagent. It was found that the appearance of the brown color of the iodine was more difficult to observe accurately than its disappearance, so that a more uniform end point could be obtained by adding a slight excess of the iodine reagent and then back-titrating with a standard water in methanol solution until the iodine color disappeared. At least four titrations were made in this manner and the results averaged. A similar number of 100-ml. aliquots of the straight synthetic methanol were also titrated with the iodine reagent and the results averaged. The volume of the Fischer iodine reagent required to titrate the known amount of added water was calculated by subtracting 9.8 per cent† of the second average from the first average, and this constituted a standardization of the reagent. The standard water in methanol solution was preserved for use in the necessary daily evaluation of the reagent.

Stability of the Reagent

The rates of deterioration of two different batches of the Karl Fischer reagent were followed for a period of one month by frequent standardizations. One batch was made up with "Eastman Grade" pyridine, the other with Eastman "Practical Grade" pyridine. The latter grade had a wider boiling range and was of lower purity. With the exception of the pyridine, the batches were identical. The results, plotted in Figure 1, show that the deterioration

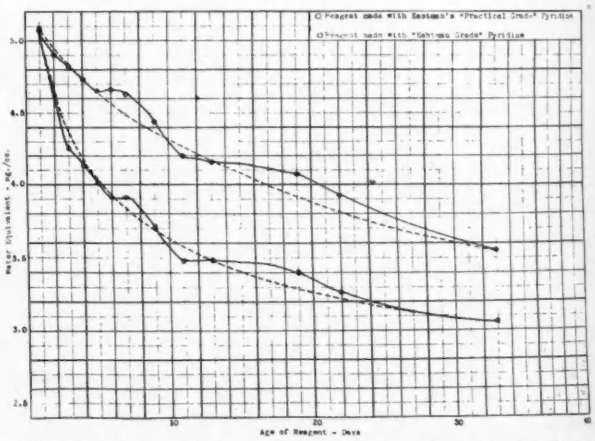

Fig. 1—Change of Titer of Karl Fischer Reagent with Age.

was rapid at the start but slowed down with age. The decrease in titer was not uniform since deviations from a smooth curve were considerably larger than the probable

*A communication to the A.A.T.C.C.

†The 10-ml. aliquot of methanol-water mixture titrated contained 9.82 ml. of methanol, whereas the aliquot of straight methanol titrated was 100 ml.

experimental errors. The rate of deterioration was sufficient at all times to warrant standardization of the reagent on the day of use.

The marked differences in the two curves checked earlier observations that the pyridine is an important factor in the decrease in strength of the reagent. Smith, Bryant and Mitchell[2] have pointed out that parasitic side reactions may be responsible for the deterioration. Whatever the cause may be, it is evident that the degree of purity is no criterion of a suitable pyridine for this reagent, but that the kind of impurity may be of major importance.

Determination of Moisture in Cotton

Specimens of cotton yarn or fabric were weighed accurately to 1 mg. and placed in a 300 ml. Erlenmeyer flask. The size of each specimen was sufficient to contain from 50 to 250 mg. of water. The specimen was covered with 100 ml. of synthetic methanol and the flask shaken for 10 minutes. The solution was then titrated with the standard Fischer reagent. After correcting for the water present in the 100 ml. of synthetic methanol, the remainder represented the water obtained from the specimen. The per cent regain was calculated by subtracting the weight of the water from the gross weight of water plus specimen and determining the proportion of water to dry specimen.

ACCURACY OF THE TITRATION

In order to check the accuracy of the end point and the uniformity of the results, approximately 10 g. of water were accurately weighed into some synthetic methanol from a weight burette. Enough methanol was added to bring the total volume to exactly 1 liter. Ten-ml. aliquots of this solution were titrated with the standard reagent. Table I shows the results of 4 titrations compared with the actual weight of water present, the usual allowance for the water in the stock synthetic methanol having been made. It will be noted that the maximum deviation was 0.06 g. and the average deviation 0.03 g. or about 0.3 per cent.

TABLE I
Titration of Known Quantity of Water

Water Per Liter by Weight	*Water Per Liter by Titration*	*Deviation from Mean*
g.	g.	g.
10.22	10.22	0.00
10.22	10.28	+0.06
10.22	10.22	0.00
10.22	10.16	—0.06
Mean	10.22	±0.03

TIME REQUIRED FOR METHANOL EXTRACTION

In order to determine the time required to complete the extraction by methanol of water from representative fabrics, samples of the fabrics were shaken in methanol for periods of time ranging from 5 to 60 minutes, and then titrated immediately with the Fischer reagent. Table II shows the results with a typical light-weight cotton fabric (bleached print cloth, 64 x 60) and a typical heavy cotton fabric (No. 5 Oceanic duck). In both the fabrics the extraction of water appeared to have been completed satisfactorily in 10 minutes. The average per cent regain found in the samples of print cloth which were extracted for 10 minutes or more was 7.45 per cent and the maximum deviation from this average was only 0.09 per cent. The average per cent regain for the samples of duck extracted 10 minutes or over was 6.59 per cent and the maximum deviation from this average was 0.10 per cent.

TABLE II
Time of Extraction of Water by Methanol

Extraction Time Minutes	*Titrated Water as Per Cent Regain*	
	Print Cloth, 64 x 60	*No. 5 Oceanic Duck*
5	7.27	5.77
10	7.48	6.49
20	7.52	6.54
30	7.42	6.67
40	7.36	6.64
50	7.40	6.68
60	7.46	6.53
90	7.50	...

TITRATION VERSUS OVEN-DRYING

A comparison was made of the relative efficiency of the titration method and standard oven-drying at 105° to 110° C.[11] for determining the moisture regain of two samples of cotton cloth, a bleached, unfinished cotton twill (96 x 64) and a bleached, unfinished broadcloth (100 x 60). The results are presented in Table III. In the case of both fabrics, the titration method showed a higher average per cent regain than the oven-drying method (0.34 per cent higher for the twill and 0.36 per cent higher for the broadcloth). Furthermore, the oven-drying results showed an average deviation from the mean of 0.04 per cent, with a maximum deviation of 0.06 per cent; whereas, the titration results showed an average deviation from the mean of only 0.02 per cent, and a maximum deviation of only 0.04 per cent.

TABLE III
Comparison of Titration Method with Standard Oven-Drying Method

	Moisture Regain			*Ave.*	*Difference*
	1 %	2 %	3 %	%	%
Twill (96 x 64)					
Oven-Drying	6.64	6.59	6.53	6.59	
Titration	6.96	6.92	6.91	6.93	+0.34
Broadcloth (100 x 60)					
Oven-Drying	6.42	6.52	6.42	6.46	
Titration	6.81	6.86	6.79	6.82	+0.36

TITRATION AFTER OVEN-DRYING

Because of the consistently lower moisture regains shown by the oven-drying method as compared with the titration method, it was decided to determine whether the titration would show any residual moisture left in the fabric samples after the oven-drying. Specimens of the cotton broadcloth (100 x 60) were first dried to constant weight in a mechanical-convection electric oven at 105° to

110° C., as provided in A.S.T.M. Specification D 629-41T[11], then immediately transferred to the standard methanol solution for the usual 10 minute extraction, after which the solution was titrated as usual with the Fischer reagent. The results in Table IV show that an average

TABLE IV
Titration of Residual Water Extracted from Oven-Dried Samples

Sample	*Moisture Regain by Titration*	*Moisture Regain by Oven-Drying*	*Residual Regain by Titration of Oven-Dried Samples*
	%	%	%
1	6.35	6.20	0.37
2	6.35	6.04	0.33
3	6.31	6.18	0.32
Ave.	6.34	6.14	0.34

of 0.34 per cent moisture regain was found by titration of the oven-dried fabric samples. It is believed that the failure of the oven drying to remove all of the moisture from the fabric was due to the presence of a slight amount of humidity in the atmosphere within the oven, even at 105° to 110° C.

In order to make sure that the so-called residual moisture was not acquired by the cloth during its transfer to the methanol solution, the transfer was made within the atmosphere of the oven and in the presence of three additional oven-dried control specimens. The controls were removed from the oven immediately after the transfer of the other samples to the methanol, then cooled in a desiccator and weighed. They showed an average regain which differed by only 0.06 per cent from the average of the first three oven-dried samples. This indicated that no appreciable moisture was picked up by the specimens during the transfer.

MOISTURE REGAINS OF REPRESENTATIVE FABRICS

The moisture in a number of representative cotton fabrics was determined both by the oven-drying method and the titration method. The results are presented in Table V.

TABLE V
Comparison of Titration Method with Standard Oven-Drying Method; Representative Fabric Samples

Cotton Sample	*Moisture Regain by Oven Drying*	*Moisture Regain by Titration*	*Difference*
	%	%	%
Starch-Sized Bleached Sheeting	6.97	7.32	0.35
Grey Sheeting 64 x 67	7.70	7.98	0.28
Bleached, Unfinished, Print Cloth 64 x 60	7.56	7.57	0.01
Bleached, Mercerized Print Cloth 64 x 60	8.91	8.99	0.08
No. 5, Oceanic Duck	6.99	7.10	0.11
Bleached, Unfinished Twill, 96 x 64	6.59	6.93	0.34
Bleached, Unfinished Broadcloth, 100 x 60	6.46	6.82	0.36
"Zelan" Treated Fabric	7.48	7.56	0.08
Untreated "Zelan" Control	8.03	8.40	0.37
40/2 C. P. Mercerized Yarn	9.17	9.36	0.19
40/2 C. P. Unmercerized Yarn	7.49	7.76	0.27

No attempt was made to condition the samples in an atmosphere of constant temperature and humidity prior to the determinations, but with each fabric the specimens for oven-drying and for titrations were cut and weighed at the same time and under the same atmospheric conditions. The titration method appeared to be equally effective whether the cotton was in yarn or fabric form, or whether the fabrics were in the grey, bleached, mercerized, finished with starch, or given a water-repellent finish with "Zelan."

CONCLUSIONS

The data presented in this paper indicate that the moisture regain of cotton textiles can be determined as accurately and more efficiently by cold extraction with methanol and subsequent titration of the water with Karl Fischer reagent, than by drying to constant weight in an oven at 105° to 110° C.

The titration method saves an appreciable amount of time over the oven-drying method when it is necessary to make a large number of moisture determinations daily. The original sample weighings require the same amount of time with either method. Sample for sample, the titration time is about the same as the time required for the first oven-drying weighings. The time consumed by the necessary second oven-dry weighings and all subsequent weighings needed to insure constant weight is saved by the titration method. The daily standardization of the titration reagent requires only a few minutes, and the reagent itself can be made up in fairly large quantities without undue difficulty or expenditure of time. If a standardized Karl Fischer reagent is available, the result can be obtained in about 30 minutes by titration, whereas at least 5 to 7 hours are required before the oven-drying is completed to a constant weight.

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Chemicals in Relation to the WAR EFFORT*

R. W. JACOBY
Ciba Company, Inc.

I AM really and sincerely sorry that your original plans did not go through to have some one from the War Production Board come down here and talk to you tonight. Pinch hitting for someone else has a lot of complications and difficulties. In the first place, one has a lot to live up to; and, in the second place, trying to do another fellow's job has all sorts of complications.

Each one of you has probably had his operations disrupted by the war effort. To you that is a problem of tremendous magnitude. But I think all of us should recognize the magnitude of the job which men like Dr. Lippert and Mr. Lanier are doing in Washington. All the difficulties experienced throughout the country by you men are funneled into Washington, and those men are trying to handle the whole business. I am sure you realize that it is almost impossible to handle a task as tremendous as that without some delays.

You have your troubles, and they have grown and will continue to grow. If there is any truth in the saying that misery loves company then you should be happy, because you have plenty of company.

We admit that there is considerable confusion existing, but it is being straightened out to a certain extent and will continue to be. I might say that it would be wise to go back and get at the cause of this confusion, or part of it. I think one point which is very important is the fact that at the beginning of our defense effort, in order to avoid delays, there was a so-called critical list of materials developed, the supply of which it was felt would not equal the demand, and they were to be diverted to the industries that needed them most in order to help out our defense effort, so-called. There was a very peculiar situation in that the list did not include dyestuffs, but many chemicals were included which were necessary in the manufacture of dyestuffs. So that led to a very peculiar situation, in that you wanted priorities to get the materials but did not have them for the dyestuffs. Another point that complicated the thing was introduction of the words "essential to civilian defense." I do not think there has been any such official classification. Everybody making socks said: "I make socks, which are essential." Those things are perhaps responsible for a lot of the misunderstanding which now exists.

While I appreciate the fact that this may be old stuff to some of you, I think it wise to show you how these things tie in. Many of the products necessary for the manufacture of dyestuffs are also extremely essential in the war effort. Take, for instance, toluene. That is of course familiar to all of you as used in T.N.T. and is also used in dyestuffs. There we had a direct overlapping of demands for that product to go into various uses.

Another instance is that of phthalic anhydride, which is used in the manufacture of smokeless powder and is used in the manufacture of impregnated fabrics for making raincoats and other products for the Army. It is also used in the manufacture of some of the vat dyes and other dyes which are necessary for the coloring of uniforms and other material for the armed forces.

Another product is salicylic acid which is used for many purposes. It has many uses but I might mention two specific ones, the manufacture of aspirin and the manufacture of dyestuffs. If you don't get the dyestuffs you might have a headache and need the aspirin, but on the other hand, as some of you dyers know, even when you do get dyestuffs, you still have headaches and, in that case, you would need both.

The next is aniline, which is used in the manufacture of the sulfa drugs and is also used in the manufacture of dimethylaniline, an explosive, and of diphenylamine, a stabilizer for gunpowder. Aniline is used in the manufacture of two or three hundred dyes which go into civilian materials like clothing, paper, hats, and so on.

We may consider this situation as being like an inverted pyramid. At the base are the basic materials—toluene, aniline, etc., for which we have an increasing demand, as represented by the spreading sides of the pyramid. We place at the center the most necessary uses, then spread out and out, and then on the sides we place the less essential needs.

If new producing units supplying the base material come into operation, the base is widened, which in turn would allow the top to be widened or, in other words, cover more materials. Then, if a new consuming unit comes into operation, the top of the pyramid would have to be narrowed to meet this new condition. This gives a varied situation, which provides a tight situation at times and becomes easier at other times.

So far as we can tell, at the present time forty per cent of the dyestuffs sold in this country are going directly into the war effort. That leaves sixty per cent. I have made this statement to several people, and they said immediately: "What about the sixty per cent?" In answer to that I can give the answer that was given to me—that is in the lap of the gods. After all, we are at war. We have only one thing to consider, and that is the production

*Presented at meeting, Piedmont Section, April 18, 1942.

of the materials necessary to supply our armed forces and to lead to final victory. Everything else must, of necessity, go by the board. That is imposing hardships upon all of you, and they are going to continue. But some of you, like myself, were on the producing end in the last war, when we had a real job on our hands. We had then no American dyestuff industry, and we had to resort to all kinds of things. You may come to the same thing now; you may have to make all kinds of substitutions. But those people with ingenuity and initiative and intestinal fortitude will meet the situation and come through, while some of those who have to have everything wrapped up and placed in their laps will fall by the wayside.

As to the fastness situation, you are going to have all kinds of problems. I think the first thing to do is to adapt the material to the use for which it is intended. We can all think of situations in which we can suit a fabric to a particular need. For instance, a high-grade dress will not go in the wash and be boiled like a kitchen apron; it will probably go to the dry cleaner.

Take, for instance, chlorine fastness, which has always been emphasized in the South, and quite rightly, especially on goods containing colored yarns, such as handkerchiefs, etc., which would have to be bleached. I think perhaps in plain shades chlorine fastness may have been overemphasized. A few years ago, a man in speaking of dyestuffs mentioned a certain group that had extreme fastness to chlorine and stated that if these colors were used, it would not matter what laundries did to them, and this statement was immediately challenged by some laundries, who stated that the laundries did not use chlorine except on white goods. I do not want to enter into any dispute with laundries as to whether or not they are using chlorine on colored goods, but the fact remains that with the laundries restricted to 10 per cent of the chlorine they have been using formerly, it is reasonable to assume that they will not have much chlorine available to use on colored goods and will conserve their supply for white goods.

The thing that cannot be done, in my estimation, is to let down the bars and use this as an excuse. You do not have to go the whole hog in turning out a poor job. It is done by some chiselers and probably will continue to be done, on the excuse that they cannot get the stuff. But you men know that is a boomerang that is going to return to you some day.

There is a lot of misinformation going around which tends to magnify the difficulties of you men and tends to cause misapprehension in the minds of the people and to lead to much more confusion than is necessary. Yesterday morning I was coming down on the train and I picked up an issue of a newspaper dated April tenth. That had one page of little, pithy paragraphs describing various things. I copied this one down word for word, so I should not misquote it, and I want to read it to you. "You cannot continue much longer to buy textiles in colors ranging from orange and yellows to tan and olive-drab. The War Production Board has prohibited the use of such dyes in any but war materials." We know that the War Production Board has restricted the use of anthraquinone colors, but to come out with a statement like that is misleading and confuses everything in everybody's mind. You men will have to combat that sort of thing more than ever.

It might be of advantage to discuss the system of priorities for a moment. Probably some of you are familiar with it, but others perhaps are not. When a war contract is let there is usually a preference rating certificate issued which gives full information as to how that preference rating is to be extended to the supplier. In addition to that there are other methods of procedure. If somebody is operating on some work, not necessarily even war work, perhaps, if he finds an item difficult to obtain he can make application to the War Production Board on a form which is called P.D.-1A. It is usually advisable to accompany that with a letter stating the situation, presenting a clear a picture as possible; and usually some sort of rating will be issued. Of course, there are now a good many blanket ratings, which are called P orders. It is stated now that it is planned to end all of those by July first and to have all American industry operating under the Production Requirement Plan. They hope to have it in extensive operation by July first.

I realize that it is a lot of work to fill out all these forms and supply the information that is asked for. On the other hand, that is a small matter to what you may be up against if you do not have some kind of rating to transmit to your supplier. You can see by the trade papers the tremendous number of orders being issued, all of which have to be interpreted. So it is very difficult even for the offices of the Governmental agencies to get the whole thing functioning smoothly.

Take the recent War Production Board Conservation Order M103 on anthraquinone colors as an example. It is very explicit. It limits the use of certain anthraquinone vat colors to war work and restricts the use of other anthraquinone vat colors and other anthraquinone colors. The restriction allows, during the present quarter the usage of 12½ per cent of the usage during the year 1941. If you used 800 lbs. of color in the group of "other anthraquinone colors," you are entitled to 100 lbs. of color in that group during the present quarter. Information has come from Washington that that quantity may be applied to any colors in the group, and you do not have to take the same color that you did in 1941.

I have tried to give you a little picture here of what is necessary. I want to go a step further and say that I feel it is the intent and the desire of the authorities to have this industry, as far as possible, police itself; and that means complete and utmost cooperation. It means that where these preference ratings are necessary people have to go to some effort to get them. Undoubtedly many of you men who have been chasing down these preference ratings have met with all kinds of rebuffs. You may say: "I sell my stuff and I do not know where it goes and

I cannot trace it down." As someone has said, if that work of tracing it down is the greatest inconvenience this war is going to cause some people, they are fortunate.

I concur in that opinion. We can be sure that production is going to be concentrated on the most necessary things. Referring to the recent order for the return of vat colors, some of you no doubt have heard the most heart-rending tale of the man who was just about to have to close down because of the lack of material. Then when the order went out to return all not used before April 30, lo and behold he had a lot of material to return. That is not cooperation.

All of us have to do our best to help in every possible way. Perhaps your plant is a beehive of industry. But when some man comes around and presses you and pushes you for this information as to extension of priorities and so forth, don't pass him up. It is for your good. It is for everybody's good. We should view the whole thing from that angle.

ERRATA: The Electron Microscope and Its Uses

By R. Bowling Barnes and Charles J. Burton

P254, May 25, 1942, issue

(A.) In Figure 3, the constant K in Abbé's Law is equal to 1.0 for axial illumination (parallel light incident upon the object), and is equal to 0.5 for oblique illumination. In actual practice, whenever a condenser is used, the illumination is very much closer to oblique than to axial. Therefore the value of K varies between 1.0 and 0.5 and should usually be thought of as being very close to 0.5.

(B.) The numerical calculations shown in Figure 3 for the wavelength of the electron and the resolving power of the electron microscope should read as follows:

$$\lambda = \sqrt{\frac{150}{V}} \times 10^{-4} \text{ microns}$$

$$\lambda = \sqrt{\frac{150}{55000}} \times 10^{-4} = 0.00005 \text{ micron}$$

$$R_{\text{Abbé}} \cong \frac{\lambda}{2\,\text{N.A.}} = \frac{5 \times 10^{-5}}{2 \times 2 \times 10^{-2}}$$

$$\cong 0.0012 \text{ micron}$$

The absolute value of the numerical aperture for any particular electron microscope is difficult to determine. Ruska has shown that the optimum numerical aperture, corresponding to the largest diameter magnetic lens which can be employed successfully to form a satisfactory image, is 0.02. If this optimum value obtains, the magnitude of the diffraction effects in the image equals that of the lens aberrations. In actual practice the effective Numerical Aperture is probably less than this value.

(C.) In column 2, page 255, a brief discussion of the formulae for the limit of resolution of optical instruments was presented. For purposes of clarification, it seems advisable to offer at this time a further discussion of the origin of these formulae.

Lord Rayleigh proposed as an arbitrary criterion for resolution that two objects be considered resolved by an optical instrument when the first diffraction minimum in the image of one object exactly coincides with the central diffraction maximum in the image of the other. Therefore the images of two small objects which are just resolved by a lens are separated by a distance equal to the radius of the first diffraction ring, or, for example, the first dark ring which surrounds the image of a star. By making use of calculations which Airy had made in 1835 of the intensity distributions within such a diffraction pattern, it can be shown that this distance is given by

$$R = \frac{1.22\,\lambda\,F}{2\,r} = 0.61\,\frac{\lambda}{\text{N.A.}}$$

where λ = the wavelength of the light used
F = the focal length of the lens
r = the radius of the lens
1.22 = a constant rising from the Bessel function used in integrating the intensity of light over the circular aperture of the lens
$\text{N.A.} = \frac{r}{f}$ = Numerical Aperture of the lens as defined by Abbé, when the refractive index between the object and the lens is equal to 1.0.

It has been further demonstrated that, for the case of a microscope, this same R represents the limit of resolution, i.e., the minimum separation which two very small objects can have and still give rise to images which are resolved according to Rayleigh's criterion.

Abbé performed a classical set of experiments with the optical microscope using a diffraction grating for his object. His results proved that the structure of such a grating can be resolved only if the objective is of such dimensions as to include simultaneously the central image and one of the 1st order diffraction spectra produced by the grating. By combining the equation governing the production of spectra by a grating, with the relationships used in geometrical optics to show the image-forming properties of a lens, Abbé concluded that a small grating space R could just be resolved if the incident light upon the grating was parallel, when

$$R = \frac{\lambda'}{\sin\theta} = \frac{\lambda}{\mu \sin\theta} = \frac{\lambda F}{\mu r} = \frac{\lambda}{\text{N.A.}}$$

where λ' = wavelength of light in a medium of refractive index = 1
λ = wavelength of light in a medium of refractive index = μ
μ = refractive index of the medium between the grating and the lens

$$\mu \sin \theta = \mu \left[\frac{\text{radius of lens}}{\text{Focal length of lens}} \right] = \text{Numerical Aperture}$$

In actual practice a condenser lens is used as part of the illuminating system, and so the incident light is far from parallel. Abbé showed that for completely oblique light a factor of 2 should be introduced into the denominator of the above equation. We can therefore for the average case write Abbé's formula for the limit of resolution as

$$R = 0.5 \frac{\lambda}{\text{N.A.}}$$

The theoretical limit of resolution of an optical microscope can then be expressed generally as

$$R = K \frac{\lambda}{\text{N.A.}}$$

where the constant K has the values

$K^{\text{Rayleigh}} = 0.61$

$K^{\text{Abbé}} = 1.0 \text{ (axial)} \rightarrow 0.5 \text{ (oblique)}$

Although very nearly equivalent, these two equations were arrived at by entirely different lines of reasoning and should not be confused.

MEETING, NEW YORK SECTION

THE regular monthly meeting of the New York Section was held on May 22nd, 1942, at the Swiss Chalet, Rochelle Park, N. J. An informal dinner preceded the meeting.

The nominating committee, consisting of Henry F. Herrmann, J. E. Meili and George L. Baxter, reported its selections as follows:

Chairman—Patrick J. Kennedy.

Vice-Chairman—Harold W. Stiegler.

Secretary—Norman A. Johnson.

Treasurer—Edward H. Schmidt.

Councilors—George A. Moran, J. Robert Bonnar, J. Ernest Meili and Kenneth H. Barnard.

Sectional Committee — George L. Baxter, Ephraim Freedman, Harry R. Tisdale and J. Ernest Meili.

They were elected unanimously.

Paul J. Luck, chairman of the outing committee, reported on his plans for the outing and announced that arrangements had been made with the Terminal Cab Company for transportation from the Erie Station in Paterson to the North Jersey Country Club.

W. S. Marsh of the Bacteriological Department, U. S. Testing Co., presented an address on the "Microbiology of Textile Fibers." This proved of considerable interest. The speaker used a number of samples to illustrate his talk.

Following Mr. Marsh's address, the retiring chairman, Harry R. Tisdale, thanked the members and officers for their cooperation in making the past season successful and then called upon Patrick J. Kennedy, chairman-elect. Mr. Kennedy asked for the continued cooperation of all during the coming season.

A rising vote of thanks was extended to Mr. Tisdale for his efforts on behalf of the section.

Respectfully submitted,

NORMAN A. JOHNSON, *Secretary.*

REPORT, NORTH CAROLINA STATE COLLEGE STUDENT CHAPTER

THE North Carolina State College Student Chapter supplied guides for the Council and Research Committee of the Association in connection with their meetings in the new Textile Building of the College on April 18, 1942, and in the evening the members of the Chapter were guests of the Piedmont Section at its banquet. Because of these meetings the Chapter was fortunate in having as speakers D. Stewart Quern, Secretary of the Piedmont Section, who spoke on "Peroxide Bleaching"; P. J. Wood, Past President, who spoke on "Hydrosulfites," and J. W. Ivey of the Mathieson Alkali Works, who spoke on "Textone."

During April, J. L. Moore and L. R. Kennettee of the du Pont Co. spoke on the "Continuous Peroxide Bleach."

Respectfully submitted,

WILLIAM R. IVEY, JR., *Secretary.*

MEMBERSHIP APPLICATIONS

Senior

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• TECHNICAL NOTES FROM FOREIGN SOURCES •

Hand Block Printing

A. Clayton—J. Soc. Dyers & Col., 57-105, *April*, 1941.—Hand block printing, considered to be the oldest form of printing known, is still of prime importance whenever the highest class of work is desired, as it is capable of producing effects which cannot be obtained by any other system. Hand printed fabrics were in use in the middle ages, and by the 15th century exhibited the elaborate designs which were developed to serve as substitutes for the costly tapestries then in use. The earliest English hand printed chintzes are believed to date from the middle of the 17th century.

Production of the wooden printing blocks in this process requires the services of three highly skilled craftsmen—the joiner, the sketcher and the cutter—while a fourth does the actual printing of the fabric with the completed design. The solidly constructed printing table consists of an iron and wood framework topped with smooth and evenly laid stone slabs, which in turn are covered with a blanket and an upper covering called the skin, upon which is stretched the fabric to be printed. Color is applied evenly to the face of the printing block, which is placed in its determined position on the cloth and struck firmly with the printer's "maul," impressing the color pattern cleanly and sharply on the fabric. The block is then lifted, re-colored and moved up the table to the next repeat position. When the length of fabric, usually from 20 to 25 yards, has been fully printed it is lifted and hung suspended above the table to dry while a new length is being stretched and printed. When completely dry the printed colors are ready to be fixed by such treatment as is required by the nature of the dyes employed.

In printing old English chintz designs the cloth must be perfectly bleached and very absorbent, three separate kier boilings usually being required in its preparation. Peroxide bleaching of such fabrics, in the opinion of the author, may be expected to give the best results. The cloth is dried by hanging in air, padded with a suitable stiffening solution, calendered without tension to remove creases, and wound on a shell before being sent to the printer's table.

The foregoing treatment of the cloth is in preparation for the "course" method which has been employed in chintz printing since the 18th century. In this method the colors are put on one type at a time, each type being steamed and washed before the next is applied. For example, the first course may consist of alizarine dyes with various mordants, the second of iron buffs mixed with sodium arsenite, the third of yellows from Persian berry and quercitron bark, and the fourth of blues and greens from prussian blue, the green being produced by printing blue over the yellows.

In such procedure, with the different fixings and washings carried out between color applications, it is said to be quite common for some types of prints to be in process for about six weeks before the goods are completed. It is therefore obvious that such printing methods can be employed only in a special field. Such a field, however, continues to exist, and it is claimed that the sharpness of third color effects produced by the colors of one course falling upon those of another course cannot be obtained in any other method of printing.

The Elasticity of Animal Fibers

Speakman & Shah—J. Soc. Dyers & Col., 51-108, *April*, 1941.—When animal fibers are deformed, the main peptide chains undergo rearrangement against the attractive forces between neighboring peptide groups, the positive and negative ions of salt linkages and the resistance offered by the co-valent cystine linkages. If a fiber is strained in a state of deformation, the internal stress is dissipated by rearrangement of molecular structure, at a rate which increases with increasing relative humidity and temperature. In steam, or in water at high temperature, the decay of tension is facilitated by disulfide bond breakdown, which is succeeded by formation of new linkages between the peptide chains. These new linkages impart a permanent set to the deformed fiber. In previous papers the influence of various reagents and the pH of the setting medium on the set acquired by the fiber has been fully examined.

Despite the importance of the subject, the rate of decay of tension in strained animal fibers has received little recent consideration. It was therefore decided to amplify an earlier study of the plasticity of wool, particularly as regards the influence of the temperature and pH of the medium on the rate of decay of tension in strained animal fibers.

In the experimental work described, human hair was selected for use because of the uniformity of diameter of the fibers along their length. In a specially constructed apparatus the previously purified fibers were stretched under carefully controlled conditions, and observations made under four main headings: (1) Rate of Relaxation as a Function of Fiber Extension; (2) Rate of Relaxation as a Function of Temperature; (3) Rate of Relaxation as a Function of the pH of the Medium, and (4) the Rate of Relaxation in Solutions of Sodium Sulfite and Sodium Metabisulfite. From the measurements taken results are expressed in a series of graphs and tables.

It was found that in distilled water at 25° C. the rate of relaxation increases with increasing extension of the fibers, and, at a constant extension of 40 per cent, with increasing temperature up to 60° C., beyond which little further change takes place. Rapid relaxation, however, can be brought about at low temperatures (25° C.) by means of agents such as alkalis, sulfites and bisulfites, which are known to cause disulfide bond breakdown.

Conversely, the rate of relaxation is least in solutions of simple acids, e.g. hydrochloric acid at pH 1, where the di-

sulfide bonds are stable. Of less importance are the salt linkages, but they may be responsible for the existence of a region, which varies in extent according to the nature of the buffers used, within the range of pH 5 to 9, where the rate of decay of tension at 25° C. is sensible independent of pH. Whatever the pH of the medium, however, the rate of relaxation can be reduced by depressing the swelling of the fibers, e.g. by means of sodium chloride.

TRADE NOTES • NEW PRODUCTS

• CIBA REVIEW

Ciba Review, for February, 1942, features the subject of "The Umbrella." Contents are described by the following titles: The Umbrella as an Emblem of Dignity and Power; From the History of the Umbrella and the Sunshade; Modish Varieties of the Umbrella; The Development of the Umbrella Industry; The Parachute; Paper Umbrellas in China and Japan; Important Umbrella Fabrics in the Nineteenth Century; Notes.

• GENERAL RELEASE

General Dyestuff Corp., 435 Hudson Street, New York City, has recently released a circular describing the following product:

Rapid Fast Scarlet ILH Powder (Patented)—the powder form of Rapid Fast Scarlet ILH Paste. It has twice the strength of the paste brand but is the same in all other respects. It is said to possess very good solubility, to show excellent stability in the print paste and to couple very rapidly. It produces bright shades of scarlet said to be characterized by very good all-around fastness properties, especially fastness to light. It is said to develop fully in a short acid ageing. It is further said to develop fully in vat or neutral ageing and can, therefore, be printed alongside vat colors. Circular G-312.

• MANAGER, CHICAGO OFFICE

Calco Chemical Division, American Cyanamid Company, takes pleasure in announcing the appointment of R. D. Howerton as manager of its Chicago Office, with headquarters at 146 West Kinzie Street.

R. D. Howerton

A native of Lexington, Virginia, Mr. Howerton was graduated from Washington & Lee University in 1922 with a degree of Bachelor of Arts in Chemistry.

After a year with the teaching staff of Staunton Military Academy in Virginia he started his business career in the textile plant of Stonecutter Mills, Spindale, North Carolina. From that time Mr. Howerton has been identified with the dyestuff and textile equipment fields.

His many friends in the dyeing and finishing field, made while he was in the South and since joining the Calco staff in Chicago, attest the high regard in which Mr. Howerton is held.

• PERSONNEL CHANGES, STEIN, HALL

Frank G. Hall, president of Stein, Hall & Co. Inc., New York, and Stein Hall Mfg. Co., Chicago, manufacturers and distributors of starches, gums and dextrines, has announced the retirement of Louis E. Leverone as general manager of the Chicago company.

Mr. Leverone, who has been associated with the company for 30 years, will continue as a vice-president, and at his request retires from the position of general manager in order to devote most of his time to his many civic and other duties. He is president of the Illinois Chamber of Commerce and of the Northwestern University Settlement in Chicago, and is active in the Dartmouth Club and other organizations in that city.

D. M. Hawley, who was appointed production director for all Stein-Hall affiliated companies some time ago, has been elected general manager and vice-president of the Chicago company, with Walter H. Hart as assistant general manager. Mr. Hart is also Secretary of the Chicago company.

Edward Butts, Jr., sales manager for the New York company is now general sales manager for both the Chicago and New York companies.

J. P. Strasser, head of the paper department, has been appointed assistant sales manager at Chicago.

Dr. Alexander Frieden continues as technical director for both companies at the New York office, and Jordan V. Bauer of the Chicago company has been appointed assistant technical director.

Organized in 1866, Stein-Hall celebrated its 75th Anniversary last year. The 50th Anniversary of Mr. Hall's service was observed two years ago.

• CHAIRMAN, PROCUREMENT COMMITTEE

George E. Westberg, New York City, has resigned as chief of the Combed Fabric unit of the WPB Textile Branch to accept the chairmanship of the Textile Joint Procurement Committee set up by the Purchase Policy Committee of WPB's Division of Purchases.

Mr. Westberg succeeds the late A. J. Rice, who died last week.

The committee is a coordinating body for the procurement of textiles for the armed forces and Lend-Lease. On the committee with Mr. Westberg are Brigadier General C. L. Corbin and Lieutenant Colonel Robert T. Stevens representing the Army, Captain Morton L. Ring and Lieutenant J. G. Dean of the Navy, and Colonel Charles R. Sanderson of the Marine Corps.

Mr. Westberg has been in the textile business since 1912. He came to the WPB last January from the Berkshire Fine Spinning Associates, Inc., of which he was sales manager and Vice-president in charge of its New York division.

Mr. Westberg will also act as commodity procurement specialist on textiles for the Division of Purchases.

• PLANT EFFICIENCY

A booklet on plant efficiency has been published by the Division of Information, War Production Board, and is now available for distribution, on request.

The booklet is called "PLANT EFFICIENCY—Ideas and Suggestions on Increasing Efficiency in Smaller Plants."

It is in simple terms and is designed primarily for smaller war plants or for plants which are just getting into war production and which might be able to increase production by a study of efficiency procedures.

Chapters in the booklet deal with "Good Lighting—Better Work"; "Cutting Down Accidents"; "Adapting Old Machines to New Jobs"; "Maintenance and Repair"; "Longer Life for Cutting Tools"; "Getting the Most out of Machine Tools"; "Production Lines Geared for War"; "Meeting Government Standards"; "Training Workers Quickly"; "Swing Shifts"; "Keeping Track of Orders, Production, and Materials"; "Plant Protection"; "Pooling Facilities"; "A Word on Priorities"; and "Getting Into War Work."

Copies may be obtained from regional and local offices of the War Production

Board, located in 120 cities; from local offices of the Division of Information, Office for Emergency Management; or by writing to the Division of Information, Office for Emergency Management, in Washington.

• RADUL

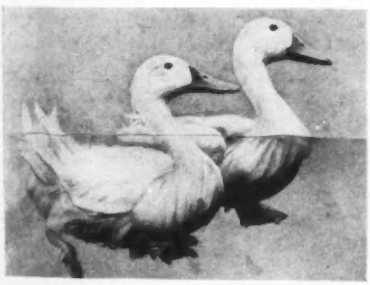
Ciba Company, Inc., Greenwich and Morton Sts., New York, N. Y. have perfected a new delustering and softening agent for synthetic fibres. It is stated that the proper dull effect on synthetic fibres in piece goods and hosiery can be retained by using Ciba's Radul. The dulling effect is said to be magnified because of the excellent dispersion and exhausting properties of the compound.

The problem of settling out and consequent spotting is said to be reduced to a minimum when Radul is used. It is claimed that additional softening agents are unnecessary with the resultant effect that the delustering and softening of synthetic fibres can be controlled in all piece goods and hosiery.

The new word, Radul, is pronounced—"Ray-dull." The application is similar to that of softening agents. For further information write to the Service Technicians, Dept. C., Ciba Co., Inc., Greenwich and Morton Sts., New York, New York.

• PERRY MASON DOES IT AGAIN

Chemists who follow the adventures of Perry Mason will find particular interest in the latest of Erle Stanley Gardner's mystery novels "The Case of the Drowning Duck" (William Morrow & Co., Inc.) The story centers around a chemistry stu-



Courtesy, American Cyanamid & Chemical Corp.

Photo above shows that ducks can be sunk.

dent who dabbles with detergents and uses a duck to illustrate their wetting-out powers. Lawyer Perry Mason enters the scene and, in his customary fast-moving pace, carries the case to a successful conclusion.

• FOXBORO BULLETIN

Instruments for the automatic measurement and recording of densities of process liquids are described and illustrated in Bulletin A-264, just issued by The Foxboro Company, Foxboro, Mass. Copies will be sent on request.

In place of periodic readings by hydrometer and still samples, the Foxboro Density Recorder records the continuous, direct measurement of the flowing liquid. For processes where automatic control of density is important for operating efficiency, the Foxboro Stabilog Density Controller is supplied. The instruments have identical measuring systems and both use standard Foxboro charts, which may be read in specific gravity, Baume, Brix or other recognized scales. It is stated that charts may be read to small unit values, and that the accuracy of the measuring and recording is not affected by turbulence, viscosity or by foam. Installation of either instrument is relatively simple. Auxiliary equipment for the installation is also shown in the bulletin.

• SALVAGE CAMPAIGN

More than 5,000,000 pounds of metal and other scrap materials needed for production of airplanes, tanks, guns and other types of war equipment have been salvaged to date by the seven plants of the American Viscose Corporation, rayon manufacturers, which commenced their "Salvage For Victory" drive on March 1.

Included in the total of 5,272,992 pounds salvaged to date are 3,567,475 pounds of iron and steel, 130,209 pounds of brass and copper, 806,729 pounds of lead, and 64,948 pounds of aluminum. The steel and iron collected is sufficient for 3,568 75mm. howitzers requiring 1,000 pounds each; for 7,136 2,000-pound aerial bombs requiring 500 pounds each; or for 71,360 50-caliber machine guns requiring 50 pounds each. Large quantities of paper, rags and miscellaneous items have also been salvaged.

• A.I.C. OFFICERS

The following new officers of the American Institute of Chemists were recently elected: President, Dr. Gustav Egloff, director of research, Universal Oil Products Company, Chicago, Illinois; Vice-President, Dr. Donald Price, technical director, National Oil Products Company, Harrison, New Jersey; Secretary, Howard S. Neiman, Patent Attorney, New York; Treasurer, Walter J. Murphy, editor, *Chemical Industries,* New York; and Councilors, Dr. Henry G. Knight, chief, Bureau of Agricultural Chemistry and Engineering, Department of Agriculture, Washington, D. C.; Dr. Foster D. Snell, president, Foster D. Snell, Inc., Brooklyn, New York, and Dr. Donald E. Andrews, professor of chemistry, The Johns Hopkins University, Baltimore, Maryland.

The retiring officers are Dr. Harry L. Fisher, director of research, U. S. Industrial Chemicals, Inc., Stamford, Conn.; and Vice-President, Dr. William T. Read, dean, School of Chemistry, Rutgers University, New Brunswick, New Jersey. Other officers were re-elected.

• JUNE MEETING, ONYX

At the monthly meeting of the Onyx Oil & Chemical Co., held on June 15th at its plant in Jersey City, N. J., Miss Irene Blunt, secretary of the National Federation of Textiles, Inc., was the speaker. Miss Blunt traced briefly the growth of the Federation from its start as the Silk Association and spoke of its recent work in connection with the development of parachutes made from nylon. She also brought out the fact that there has been considerable cooperation and exchange of information among various groups and agencies in recent months in furtherance of the war effort. The work of the Federation in education of consumer groups and arbitration of disputes was also discussed.

• JUNE ISSUE, TEXTILE RESEARCH

A report of a recent meeting of representatives of Government War Agencies with technical representatives of textile trade associations and other interested groups, and with the Textile Research Institute and the Textile Foundation, is given in the June issue of *Textile Research.* At this meeting war problems were discussed and steps outlined with a view of securing prompt action in clearing textile war problems involving research.

An article on ramie also appears in this issue. Ramie is one of the strongest of textile fibers and it can be successfully cultivated in the gulf costal area. The present handicap is in the difficulty of decorticating the fiber so as to preserve its elasticity and not leave a brittle fiber. This article is a report of exhaustive studies made under the direction of Louisiana State University and the Institute of Industrial Research. The subject is of particularly timely interest due to the need of substitute fibers in our war program.

Other features in the June issue are a report on the results of increasing the cylinder speed of cotton cards equipped with metallic clothing. This supplements the report in the April issue which gave results of a mill test run on cards equipped with fillet clothing, and shows comparable results. Also there appears an article reviewing the progress in increasing the tensile strength of rayon and alluding to its importance to our armed forces.

• 1942 FALL HOSIERY COLORS

Flying Colors is the caption for the three shades portrayed in the Confidential Advance Hosiery Card for Fall 1942, just issued by The Textile Color Card Association to its members. This trio, called Glorious, Valorous and Victorious, is closely linked to the master theme of United Victory Colors, featured in the Association's 1942 Fall Woolen and Rayon Cards.

A Service Study of Three
BLANKET FABRICS
Made from Various Blends of Wool and Mohair

RUTH ELMQUIST ROGERS,
Textile Chemist
U. S. Bureau of Home Economics

MARGARET B. HAYS
Textile Physicist

and J. I. HARDY
Senior Animal Husbandman
*U. S. Bureau of Animal Industry**

THE Wool Products Labeling Act of 1939 which became effective July 15, 1941, requires that new, reprocessed, and reused wool be designated on the label of articles containing wool. This act not only has increased the public interest in, but also the necessity for investigations of the serviceability of fabrics made from various wools. Such studies also are needed to assist producers and manufacturers in meeting consumers' requirements and in bringing more desirable fabrics on the market. It is especially important to know the use-value of various qualities of new wool and possible substitute fibers when there is a threatened shortage of wool as in the present emergency.

In 1937 the United States Department of Agriculture reported a study on the serviceability of blankets made from four blends of Rambouillet and Corriedale wool[6]. This previous investigation and the work reported herein on blankets made from blends of new Corriedale wool, reworked wool†, and new mohair are believed to be the only ones in which wool fabrics of known production history have been submitted to both laboratory and service tests. Bailey[1] studied the fabric properties of suitings made from blends of new Rambouillet wool and reworked wool† after repeated dry cleanings but did not subject these fabrics to wear.

THE WOOL AND ITS MANUFACTURE INTO FABRICS

The new wool used in this experiment was selected from individuals of the purebred Corriedale sheep flock at the United States Experiment Station, Dubois, Idaho. Some of the fleeces were classed as good quality and some as poor quality, all being of ⅜-blood fineness.

The sorting and scouring of the wool was done at a commercial wool scouring establishment under typical plant conditions**. A regular four-bowl commercial scouring machine was used in which the temperature and strength of solution were regulated to give a medium degree of scouring. The temperatures for the successive four bowls were 135°, 130°, 130°, and 80° F., respectively, and the wool was dried at from 160° to 185° F. The yield of clean wool was 49.4 per cent.

The new scoured wool was put through a burr picker. The good wool lost 4.4 per cent and the poor, 5.6 per cent in weight.

All the reworked wool consisted of good white knits designated commercially as Diamond White Knit No. 39. Short mohair noils were purchased. Both reworked wool and the new mohair were comparable in fineness to ⅜-blood wool.

Three different blanket fabrics were made by blending the new wool classed as good quality with the new wool classed as poor, with reworked wool, and with new mohair, in the proportions shown in Table 1. These proportions were measured by weight.

TABLE 1
Fiber content and fiber diameter of blends of wool and mohair for the three blanket fabrics

Fabric No.	*Fiber content**	*Blended fineness (Mean diameter of fibers in roving)*
		Microns
1	1 part poor wool 2 parts good wool	24.7
2	1 part reworked wool 3 parts good wool	24.8
3	1 part mohair noil 3 parts good wool	24.7

*The fiber content of warp and filling yarns is identical.

The wool was mixed, then oiled. Blending of the oiled wool was accomplished by a Fearnaught picker. The blended stock was fed to the carding machine, first to the breaker card, next through the second breaker or intermediate card, and finally into the finisher and condenser to produce the roving.

The yarns were "mule" spun. Their yarn number, twist per inch, and breaking strength are given in Table 2.

Blanket fabrics were woven in a 2-up-and-2-down twill. There were 1,580 ends on the beam, the loom width was

*Acknowledgment is made to Harold W. Wolf, Bureau of Animal Industry, and to Helen G. Wheeler and Gertrude Lowell of the Bureau of Home Economics for assistance in this study.

†Prior to the passage of the Wool Products Labeling Act of 1939, wool fibers obtained from knit goods were designated as reworked wool.

**The wool was scoured by the Norwood Wool Scouring Company, Norwood, Mass. Other manufacturing operations were performed by the Nashua Manufacturing Company, Nashua, N. H.

TABLE 2

Number, twist, and strength of yarns used in weaving the blanket fabrics

Fabric No.	*Yarn*	*Yarn No.**	*Twist per inch**	*Skein strength test of yarn**
		Run	*Number*	*Pounds*
1	Warp	2½	9.3	112
	Filling	1¾	6.0	151
2	Warp	2½	7.4	112
	Filling	1¾	6.0	151
3	Warp	2½	8.5	100
	Filling	1¾	5.2	155

*Test made in the laboratory of the Nashua Manufacturing Co.

87 inches, and there were 30 picks per inch. The fabrics were fulled with a soap solution, scoured at 95° to 105° F. and dried at 160° F. They were given a medium degree of napping as were the blankets used in the previous study[6]. The blankets were neither bleached nor dyed and were finished to 60 by 84 inches The cut edges were double whipstitched.

According to the Rules and Regulations under the Wool Products Labeling Act of 1939[3], all three fabrics might be labeled as 100 per cent new wool. It should be noted that fabric 1 is a blend of two parts good new wool and one part poor new wool; that fabric 2 is composed of three parts good new wool and one part of reworked fiber obtained from white knits; and that fabric 3 consists of three parts of good new wool and one part of new mohair.

PROCEDURE

Six blankets* of each fabric were given identification numbers and put into use at the United States Naval Hospital, Washington, D. C. They were laundered after each 2-week period of service.

*Other blankets of each lot are still in service in another Washington hospital and are being removed for testing at the same intervals as in this study.

The regular hospital laundering procedure was used. Six blankets were washed at a time in a 36-inch rib washer in the hospital laundry. Lukewarm water kept at a 12- to 14-inch level and soap chips were used in each of the two 3- to 4-minute suds given the blankets. After washing, the blankets were extracted 4 minutes and then were tumbled 20 to 25 minutes in a drier operated at 92 pounds steam pressure (approximately 320° F.).

The date each blanket was laundered was recorded in the office of the director of nursing. One blanket of each lot was removed and subjected to laboratory analysis after each 12 periods of wear and laundering up to and including 60 washes. One period consisted of 2 weeks' use in a ward and one laundering. Two blankets of fabric 1 were lost in service so no blanket of this group was available for testing at 60 launderings.

The fineness of the fiber in the roving was determined by Hardy's method[4] in which the major and minor diameters of the fiber cross-section were measured. The average of 100 of these measurements was taken as the fineness of the fibers (see Table 1).

The damage existing in the fibers of the yarn was determined microscopically. The yarns were untwisted and individual wool fibers carefully pulled out. These fibers were then mounted in glycerine on a microscope slide and examined at a magnification of about 250 diameters. The ends were classified into five groups (Fig. 1), ranging from undamaged types such as smoothly cut and pointed ends to the extremely damaged ends of the frayed and broken type. At least 500 ends were examined and classified for each fabric.

A new technique was used to measure the lengths of fibers within the yarns. The yarns were cut into one centimeter lengths while under sufficient tension to re-

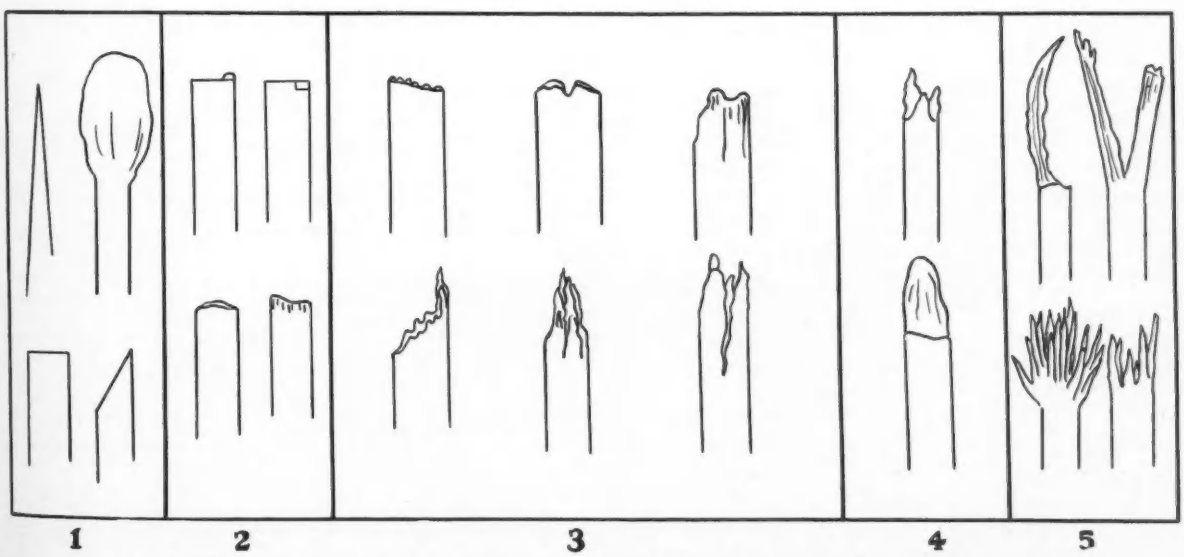


Figure 1—Classification of wool fiber ends into 5 groups ranging from undamaged to extremely damaged ends.

move the curl or crimp. The fibers were then removed from the yarn, mounted between two lantern slides, and their projected lengths measured at a magnification of ten diameters.

The blankets were measured at three places for length and width to the nearest sixteenth of an inch when new and after laundering. The percentage of shrinkage was calculated from these data.

For the other physical tests on fabrics, the blankets were sampled in the same way as in the previous blanket investigation[6], that is, diagonally across the blanket in such a way that for any one test no warp or filling yarns were duplicated. All samples were conditioned and tested in a laboratory maintained at 70° F. and 65 per cent relative humidity. Tests for breaking strength (both grab and strip), count, weight, air permeability, and heat transmission were made by the methods previously reported[6], which conform to existing established procedures. Standard thickness, total compression, compressibility, and compressional resilience were calculated from the thickness readings determined with a compressometer[8] as the pressure was increased from 0.1 to 2.0 pounds per square inch and then decreased to 0.1 pound. This cycle was completed in 3 minutes.

At each test period the chemical determinations—cystine sulfur, alkali solubility, and methylene blue absorption—were made. Chemical deterioration of wool is indicated by a decrease in cystine sulfur or by an increase in alkali solubility or methylene blue absorption. The ash content was obtained for the new blankets and for those laundered 48 times. Each chemical determination on any one blanket was made on a separate sample cut from widely separated parts of the blanket.

The percentage of cystine sulfur was determined by Mease's method[7], whereby the amount of sulfate sulfur is subtracted from that of total sulfur. Methylene blue absorption was measured by the procedure of Elmquist and Hartley[2] in which methylene blue is titrated with Naphthol Yellow S. The alkali solubility test described by Harris and Smith[5] was used. In this test the loss in weight of wool is determined after treatment with a 0.1 N solution of sodium hydroxide at 65° C. for 1 hour. Ash was determined by igniting a 2-gram sample of fabric moistened to prevent froathing with a saturated solution of ammonium nitrate in 67-per cent alcohol.

RESULTS

The values for fiber end damage found in the fabric before laundering are given in Table 3. Fibers in fabric 3 appeared less damaged than those in fabrics 1 and 2. Of these last two, fabric 2 apparently is the poorest since it has the lowest percentage of undamaged and slightly damaged fibers, groups 1 and 2 in this test, respectively. The higher percentage of slightly damaged fibers (group 2) in fabric 1 as compared to fabric 2 is probably due to the poor quality wool added to fabric 1. Poor wool tends toward this type of damage.

The length of the fibers in one centimeter of yarn is given in Table 3. Fabric 3 has the longest average fiber length with the fibers distributed in such a manner that only 48.9 per cent are equal to or less than one centimeter. The three fabrics may be rated in the same order on the basis of fiber length as on end damage, that is, fabric 3, fabric 1, and fabric 2 in the order of increasing damage.

Table 4 shows that all these blanket fabrics shrank with the first 12 launderings, and that additional washings did not increase the amount of shrinkage. The substitution of mohair for wool failed to reduce blanket shrinkage although mohair has a smoother surface structure than wool. In fact fabric 1, containing all new wool, shrank less than either fabric 2 with reworked wool, or fabric 3 with new mohair.

Breaking strength values as determined by the grab method are higher than by the strip test in this study as in most others (Table 4). The strip samples were taken in groups of five from each of three places along the diagonal of the blanket. An analysis of variance[9] showed that the variation due to location was not significant* For this reason the data were analyzed as 15 separate determinations rather than as three groups of five each. Only five determinations were made for grab breaking strength and these samples were taken from the center of the blanket.

An analysis of variance of the breaking strength data for the test blankets up to and including 48 washes showed that fiber blend produced a significant difference in both warp and filling breaking strength by the strip method and

*Any difference exceeding the 5 per cent level will be considered significant in the discussion of results.

TABLE 3
Classification of wool fiber ends by amount of damage, and length of fibers for 3 blanket fabrics

Fabric No.	*Percentage distribution by end damage groups**					*Length of fibers*	
	1	2	3	4	5	*Fiber length in one cm. yarn*	*Fibers equal to or shorter than 1 cm.*
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Cm.*	*Per cent*
1	34.4	22.3	30.4	3.8	9.1	0.996	57.7
2	32.6	17.2	32.6	5.0	12.6	.954	65.7
3	41.0	21.8	25.2	5.0	7.0	1.030	48.9

*See Figure 1. Extent of end damage increases from group 1 (undamaged) to group 5 (extremely damaged).

TABLE 4

Shrinkage, breaking strength (grab and strip) and count of three blanket fabrics tested after various periods of service

Fabric No.	Times Laundered	Shrinkage*		Breaking strength				Count†	
				Grab†		Strip**			
		Length	Width	Warp	Filling	Warp	Filling	Warp	Filling
	Number	Per cent	Per cent	Pounds	Pounds	Pounds	Pounds	Number	Number
1	0	...	...	47.2	80.9	25.2	40.5	27.0	35.0
	12	17.3	16.2	57.1	105.5	31.2	52.1	27.4	38.6
	24	19.8	17.6	61.7	107.1	30.5	51.0	32.2	44.2
	36	18.9	16.6	57.8	98.8	26.7	47.2	32.8	43.4
	48	19.7	16.2	55.6	105.1	28.3	52.2	32.4	43.6
2	0	...	...	38.6	62.1	20.9	30.9	26.6	33.2
	12	25.6	21.4	53.6	94.9	25.6	44.0	28.8	37.0
	24	25.8	20.6	51.5	97.2	25.3	42.9	30.8	41.4
	36	26.3	22.0	55.2	90.4	23.6	42.8	35.2	44.6
	48	27.3	23.6	55.6	97.6	24.4	44.1	34.4	46.4
	60	24.4	20.0	50.7	90.4	24.4	45.3	34.6	42.0
3	0	...	...	39.5	61.2	21.0	31.7	26.0	32.8
	12	21.5	23.0	60.9	103.8	30.2	49.0	29.2	36.8
	24	22.5	24.1	63.8	99.4	30.4	45.1	30.6	40.8
	36	25.8	26.2	64.5	103.4	29.5	46.5	35.6	44.4
	48	24.0	25.8	67.6	103.3	30.7	45.4	35.6	46.2
	60	22.3	24.3	58.9	101.0	29.3	46.3	35.0	43.8

*Average of 3 determinations.
†Average of 5 determinations.
**Average of 15 determinations.

in the warp direction by the grab test (Table 7). The interaction of service and fabric was used to test the significance of the results.

Individual comparisons between the breaking strength of blankets of the three fiber blends showed that fabric 1, all new wool, is significantly stronger in the filling direction than fabric 2, part reworked wool, by both methods. In the warp direction, fabric 1 is significantly stronger only by the strip method. The only significant difference between the all new-wool fabric 1 and fabric 3, which contain mohair, occurs in the filling direction by the strip method, the all new-wool blanket being stronger. Fabric 3 is significantly stronger than fabric 2 in the warp direction by both methods and in the filling direction by the strip test. On the whole, breaking strength decreased from fabric 1 to fabric 3 to fabric 2.

Service in the analysis of variance also is significant. Individual comparisons between different test periods show a significant difference between the unlaundered blankets and those removed at the 12-wash period in both the warp and filling directions by both test methods. Increasing amounts of laundering, however, did not produce further significant changes in strength.

Breaking strength of the filling by the strip method showed more significant differences between fabrics than did the warp strength or either grab breaking strengths. This indicates that an investigator studying fiber or construction differences in blankets and wishing to reduce the testing load or save test material might limit the study to filling breaking strength by the strip method.

The three fabrics are comparable in yarn count. Fabric 1 has two more filling yarns per inch than fabrics 2 or 3 but this is an accepted manufacturing tolerance. In general the count, both warp and filling, increased with service during the first 36 washes (Table 4).

As shown in Table 5, all three fabrics increased in weight per square yard with 12 launderings and then remained almost constant in weight as service progressed. In the previous investigation[6] the two blanket fabrics containing all new wool showed a similar gain in weight while the two materials containing three-fourths or all reworked wool lost weight as service continued. This suggests that it is possible to substitute small amounts of reprocessed wool, poor quality new wool, or new mohair and still have the material react like all new-wool fabric with respect to weight.

After the first test period, all three fabrics increased in standard thickness, that is, thickness measured at 1 pound pressure. However, increasing amounts of laundering did not produce any greater changes than would be expected from sampling variation (Table 5).

The total compression in the pressure range 0.1 to 2.0 pounds per square inch is 0.080, 0.079, and 0.085 inch for unlaundered fabrics 1, 2, and 3, respectively. It is lower for all the laundered blankets, whereas Schiefer[8] reported that an increase in total compression was produced by laundering. This difference is probably due to the fact that the blankets in the two studies were laundered by different procedures.

The softness of a blanket after laundering is important. The compressibility and compressional resilience according to Schiefer[8] affect the sensations that contribute to what is usually called the softness or harshness of cloth. However, no standards for softness have ever been established.

The compressibility values, the ratios of the rate of decrease in thickness at 1 pound pressure to the standard thickness, are 0.25, 0.28 and 0.30 for fabrics 1, 2, and 3, respectively. These values are quite similar since com-

TABLE 5

Weight, thickness, total compression, compressibility, compressional resilience, air permeability and heat transmission of three blanket fabrics tested after various amounts of wear and laundering

Fabric No.	*Times laundered*	*Weight per square yard**	*Standard thickness**	*Total compression**	*Compressibility**	*Compressional resilience**	*Air permeability†*	*Heat transmission***
	Number	*Ounces*	*Inches*	*Inches*	*Square inches per pound*	*Per cent*	*Cu. ft./min./sq. ft. at a pressure difference of 1 lb. per sq. ft.*	*Cal./°C./sec./ 1000 cm.²*
	0	14.5	0.113	0.080	0.25	33	41	0.104
	12	20.3	.137	.053	.13	37	18	.089
1	24	21.2	.142	.057	.13	36	16	0.81
	36	20.5	.139	.058	.14	34	17	.083
	48	20.3	.141	.060	.14	35	17	.091
	0	12.7	.109	.079	.28	31	46	.113
	12	20.8	.140	.051	.12	36	17	.074
2	24	20.6	.142	.058	.14	36	20	.082
	36	20.9	.142	.059	.14	35	16	.088
	48	21.3	.147	.070	.14	33	18	.090
	60	21.8	.150	.063	.14	35	13	.088
	0	12.6	.107	.085	.30	33	44	.102
	12	19.8	.141	.061	.14	35	18	.079
3	24	20.5	.141	.052	.12	36	16	.086
	36	21.0	.147	.066	.14	34	19	.080
	48	21.0	.148	.067	.15	34	19	.084
	60	21.1	.147	.060	.14	34	15	.103

*Average of 5 determinations.
†Average of 3 determinations.
**1 determination only.

pressibility depends mainly on the structure of the specimen, and these three fabrics were manufactured in similar fabric constructions. The compressibility results are much lower for laundered blankets, probably due to felting. All three fabrics, regardless of fiber blend, reacted similarly to laundering.

Compressional resilience is the ratio of the work recovered when the pressure is decreased from 2.0 to 0.1 pound to the work done when the pressure is increased from 0.1 to 2.0 pounds. The value for the new blankets are 33, 31, and 33 per cent for fabrics 1, 2, and 3, respectively. After laundering they are somewhat higher but still are lower than Schiefer's values[8] for laundered all-wool blankets.

According to individual comparisons, fabric 2 containing reworked wool, and fabric 3 with part mohair, are significantly more permeable to air than fabric 1 containing all new wool. Fabrics 2 and 3 do not differ significantly. Although this mathematical difference exists between the values for these fiber blends, it is so small that from a practical standpoint the three fabrics have equal resistance to air penetration.

Laundering reduced the air permeability values significantly (Table 5). This may be due to the felting resulting from laundering. For example, fabric 1 decreased from 41 to 18 cu. ft. per min. per sq. ft. With increased laundering there is no significant difference in the values.

No significant difference was found in the amount of heat transmitted by the three fabrics. Since all three were made in the same fabric construction, the difference in fiber blend apparently was not sufficient to produce a significant change in thermal insulation. The values for the laundered blankets were significantly lower than those for the unlaundered although increasing amounts of laundering produced no further significant changes.

The sulfur content of the new fabric containing mohair is less than that of the new fabric containing either poor quality new wool or reworked wool (Table 6). Lower values for the mohair blankets persist throughout service. The sulfur content of mohair like that of wool varies with the origin of the fiber. Individual comparisons for fiber blend in an analysis of variance show that the difference between the sulfur content of the blankets containing mohair and that of those of the other two fabrics is significant. No definite variation exists between the sulfur contents of the blankets of fabric 1, all new-wool, and fabric 2 containing reworked wool.

Service produced a significant change in sulfur values according to the analysis of variance. Individual comparisons for the service factor show that there are no significant differences among the values for the 12, 24, 36, and 48 periods of service. There is a definite variation, however, between the values for any one of these periods and the unlaundered blankets.

The alkali-solubility values for the blankets containing reworked wool are significantly higher than the corresponding values for the blankets of all new wool. This indicates that the addition of reworked wool caused blankets to deteriorate more than the addition of the poor quality new wool. There is no significant difference between the alkali solubility values for the blankets containing mohair and those containing the reworked wool.

When individual comparisons for service are made on

TABLE 6

Sulfur, alkali solubility, and methylene blue absorption of three blanket fabrics tested after various amounts of service

Fabric No.	Times laundered	Sulfur*	Alkali solubility*	Methylene blue absorption†
	Number	Per cent	Per cent	**
1	0	3.57	14.8	9.1
	12	3.48	16.9	12.5
	24	3.47	15.6	12.4
	36	3.51	16.4	12.7
	48	3.49	16.1	12.5
	60	...	...	...
2	0	3.54	16.2	12.9
	12	3.46	17.5	15.8
	24	3.46	17.9	15.5
	36	3.43	17.3	15.9
	48	3.43	17.4	15.7
	60	3.38	17.8	16.8
3	0	3.42	15.9	9.4
	12	3.28	18.0	11.6
	24	3.29	17.4	12.0
	36	3.21	17.3	12.5
	48	3.22	17.3	12.2
	60	3.22	18.6	12.2

*Average of 3 determinations.
†Average of 4 determinations.
**Mols of Methylene Blue absorbed by 100 g. of dry wool.

the alkali solubility data, a significant change was found between the unused blankets and those at any of the other test periods. No difference greater than that attributable to chance was found between any two of the values at the 12, 24, 36, or 48 periods.

As shown by the analysis of variance, the difference for fiber blend in the methylene blue values, that is, the mols of methylene blue absorbed by 100 grams of dry wool, is significant. Individual comparisons show that the values for the reworked wool blankets are significantly higher than those of either fabric 1 or fabric 3. The latter do not differ significantly from each other. Apparently the addition of fibers reworked from white knits produced more chemical deterioration than the addition of poor quality new wool or mohair.

As shown in Table 7 the source of variation, between periods of service, also is significant according to the methylene blue data. Individual comparisons show that the values for the unlaundered fabrics are significantly different from those of the laundered but that there are no definite variations between the values obtained at different periods of wear.

The blankets containing reworked wool gave the highest percentage of ash. The average value for ash found for the unlaundered blanket of fabric 2, containing reworked wool, is 0.52 per cent and for fabrics 1, all new wool, and 3, part mohair, 0.42 and 0.40 per cent, respectively. Service caused only a small increase in ash content. After 48 periods of wear and laundering the values for fabrics 1, 2, and 3 are 0.59, 0.72, and 0.56 per cent, respectively.

SUMMARY AND CONCLUSIONS

Blankets were manufactured from good quality new Corriedale wool blended with new Corriedale wool of poor quality, with reworked wool, and with mohair. They were put into use in a government hospital and test blankets were withdrawn from service at intervals in order to measure the deterioration due to wear and laundering.

As measured by laboratory tests throughout service, the fabrics would rate in general in the following order of decreasing use-value: Fabric 1, all new wool; fabric 3, containing new mohair; and fabric 2, containing reworked wool. The differences between fabrics, however, are small and in heat transmission these differences are not even mathematically significant.

An analysis of variance shows that fabric 1, containing poor quality new wool, differs significantly from fabric 2, containing reworked wool, as measured by filling breaking strength both strip and grab, warp strength as determined by the strip method, air permeability, alkali solubility, and methylene blue absorption. According to these tests, fabric 1, part poor quality new wool, is superior to fabric 2, part reworked wool. Tests for fiber quality on new blankets rated the two fabrics in the same order.

Fabric 3 differs significantly from fabric 1 in strip breaking strength, air permeability, cystine sulfur content, and alkali solubility. Fabric 2 differs from fabric 3 in the warp breaking strength by both strip and grab tests, in filling strength by the strip method, sulfur and methylene blue. Fabric 3 is deteriorated more than fabric 1 but less than fabric 2. Tests for fiber end damage and length of fibers on unlaundered blankets, however, show that fabric 3 is least damaged.

The breaking strength determined by the strip method showed more significant differences between fabrics than by the grab method. Also there were more significant

TABLE 7

Analysis of variance of some physical and chemical properties of three blanket fabrics given different amounts of service

Source of variation	Breaking strength (grab)			Breaking strength (strip)			Air permeability		Heat transmission		Sulfur		Alkali solubility		Methylene Blue absorption	
		Mean square			Mean square											
	D/F	Warp	Filling	D/F	Warp	Filling	D/F	Mean Square	D/F	Mean Square	D/F	Mean Square	D/F	Mean Square	D/F	Mean Square
Between fiber blends	2	442.1*[1]	762.3	2	489.2**	1143.1**	2	8.9	2	0.000050	2	0.2069**	2	8.00*	2	82.97**
Between periods of service	4	877.1**	3210.4**	4	331.3**	1447.7**	4	1217.8**	4	.000325**	4	.0267**	4	4.25*	4	21.26**
Blend x service	8	77.0[2]	111.8[2]	8	38.5[2]	42.7[2]	8	7.4[2]	8	.000025[2]	8	.0032[2]	8	.38[2]	8	.25[2]
Between replicates	60	8.4	22.9	210	1.3	2.7	30	1.0	.	.....	30	.0012	30	.47	45	.10

[1]A double asterisk indicates that the variation exceeds the 1 per cent level and a single asterisk, the 5 per cent level.
[2]Error term.

differences in the filling direction than in the warp.

As shown by laboratory analyses, significant changes were produced in blankets by service, but increasing amounts of wear and laundering did not produce progressive changes in the various properties. In this study none of the blankets were worn out after 48 or 60 launderings representing 96 and 120 weeks of wear, respectively.

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Laundry Processes—

(Concluded from page 306)

Similarly after 100 washes the wringer and spinner caused no significant difference in fluidity increase or in tensile strength with the exception that the spinner used in combination with the gyrator lowers the tensile strength. Whiteness retention and detergency efficiency were greater with wringer than wtih the spinner.

Finally, if the housewife prefers wear to appearance indoor drying is preferable to outdoor drying since the degradation as measured by the tensile strength and fluidity increase was less. To offset these advantages, however, we find that the whiteness retention and the detergency efficiency was lessened on indoor drying.

SUMMARY

Standard cotton test bundles were washed 100 times in a domestic process using various types of domestic mechanical equipment, and in a controlled commercial process. By a statisitcal analysis of the data it was found that in the washing of cotton—

1. For soil removal the commercial process is superior to all domestic processes.
2. For tensile strength loss the commercial process compares favorably with the domestic processes in which samples were dried outdoors but loss in strength is greater in the commercially washed samples than in those washed domestically and dried indoors.
3. Chemical degradation is least when clothes are dried indoors as in the commercial method and in the domestic process using indoor drying.
4. The gyrator and vacuum cup gave similar results for degradation and tensile strength loss. The detergency efficiency of the gyrator in most cases was slightly superior to the vaccum cup.
5. The wringer aids materially in soil removal and is superior in this respect to the spinner extractor.
6. From the standpoint of wear indoor drying is preferable to outdoor, but for whiteness retention outdoor drying is preferable.

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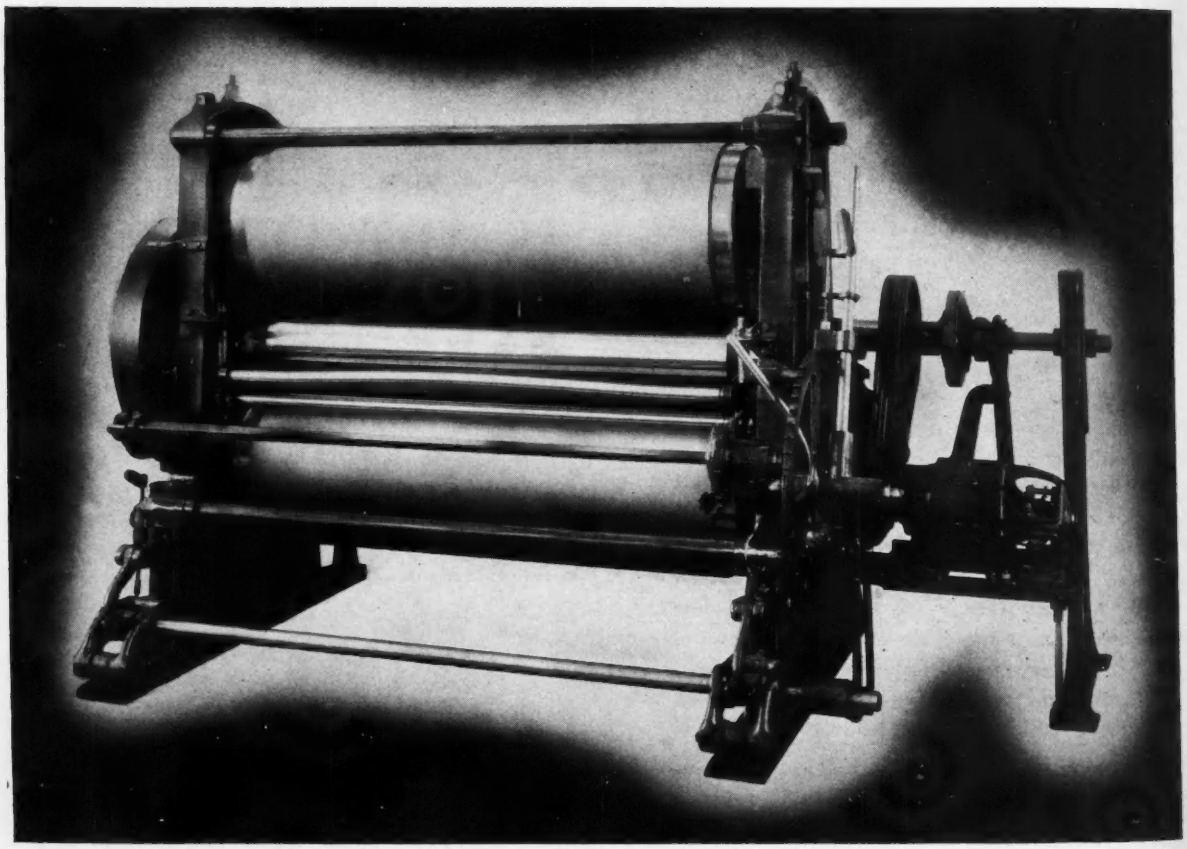

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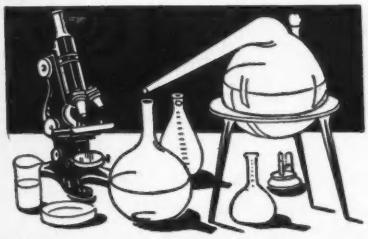

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Nevillac and P.H.O. are used in conjunction with Ethyl Cellulose 10 cps., and Chlorinated Paraffin.

- If desired, the resins may be supplied in solution form in various cuts with suitable solvents.

RESINS
PARADENE*
R-16-A
R-33
NEVILLAC*

PLASTICIZING OILS
NEVINOL*
P.H.O.*

*REG. U.S. PAT. OFF.

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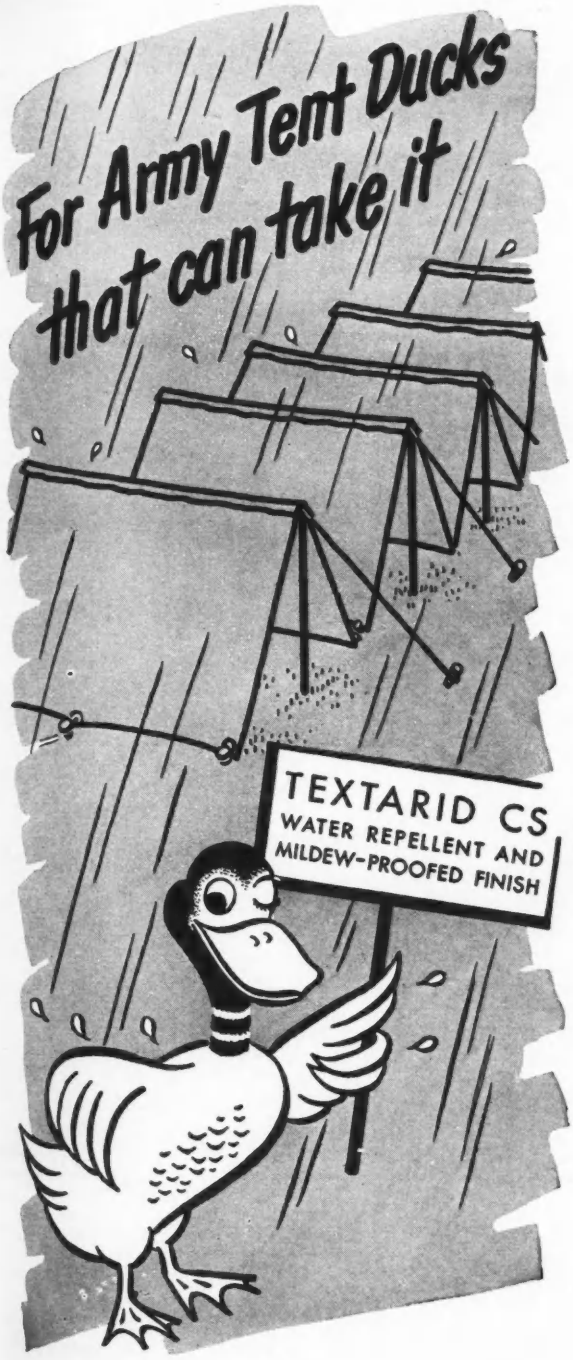

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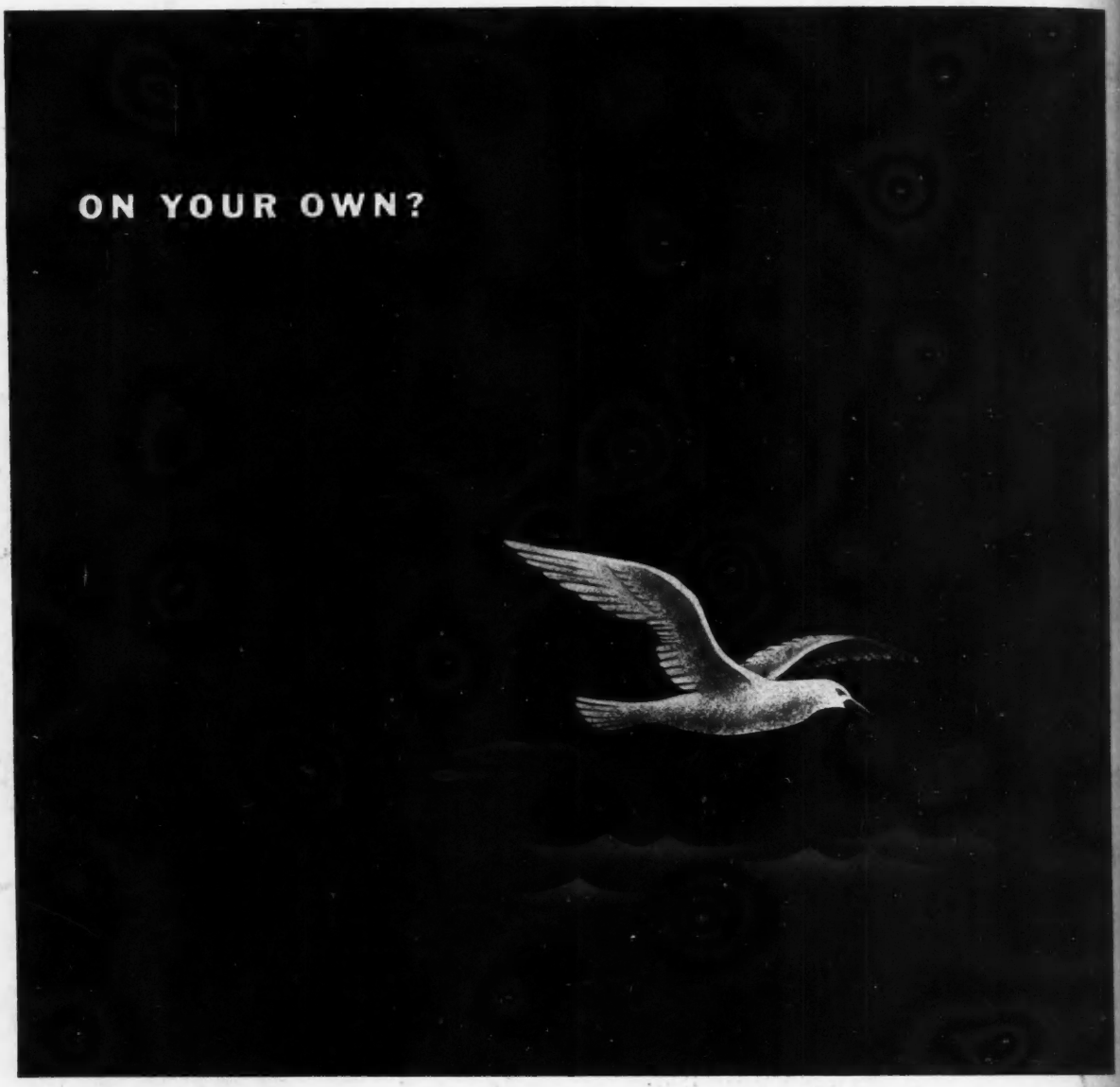

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